



Fixation of Carbon dioxide and oxygen production by photosynthetic simulations in indoor environs

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Abstract

Utilization of electronic equipments and increase in global warming has adversely affected the ratio of gases in indoor environment particularly favoring carbon monoxide and nitrous oxides. Photosynthetic organisms have a great potential to sequester carbon di oxide and generate oxygen. The study was conducted to ascertain the oxygen production and carbon abstraction potential of two species of green algae (*Chlorococcum sp* and *Desmococcus sp.*) and two species of blue green algae (*Oscillatoria sp* and *Spirulina sp*). Results revealed the fact that green alga, especially *Chlorococcum sp.* has greater potential to reduce the stress on the global warming effect with a maximum production of 6.02 mg/l of oxygen for every 18×10^4 cells/ml of culture during day time per hour of light period, during this process it abstracts 8.27 mg of carbon dioxide. The investigation indicates the potential of microalgae as an indoor carbon removal tool. This inference categorically harbingers that green algae can serve an ideal indoor photosynthetic organism in producing sizeable quantity of oxygen creating a healthy indoor environment.

Keywords: *Oscillatoria sp*, *Chlorococcum sp*, *Desmococcus sp*, *Spirulina sp*, oxygen, carbon dioxide.

Introduction

The impact of Global warming is being realized at macro and micro scale. Efforts need to be continued in mitigating this in spite of tangible costs, factoring in the long term intangible losses in quality of life.

Modern gadgets and lifestyle coerce us to squander the resources beyond the carrying capacity of the mother earth. In this issue human's greed is far exceeding his necessity leading to a hidden destiny of his own extermination. Fossil fuel usage is beyond

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the recuperation limits generating colossal quantities of carbon dioxide and nitrous oxides. This manmade CO₂ emission upsets the natural equilibrium and buffering capacities (skepticalscience.com). Vehicular traffic, industrial development and associated activities are becoming inevitable and even ecologists are compelled to compromise on many issues as there is no other alternative to meet the demand.

Under these circumstances plants are deemed to be the panacea against this ecotrauma. So far only terrestrial plants have been given due consideration in containing this issue. But recent awareness and alertness about aquatic microphytes and macrophyte in this dimension is increasing. Aquatic bodies so far underutilized can remarkably contribute with this orientation reducing pressure on premium forest lands. Now due to closed door living, indoor carbon dioxide levels are building up depleting the oxygen, antagonizing the health heavily (Manikandavelu, 2008).

With this backdrop this study has been carried out to evaluate the carbon fixation potential and oxygen production. All plants produce oxygen, some are a little more productive than others. In the aquatic environment, there is a number of species appreciated for their "oxygenating" abilities.

However, there exist a relationship between the spectral light absorption and the amount of oxygen produced. Photosynthetic rates were measured as the difference in dissolved oxygen concentration between transparent and opaque bottles.

Material and Methods

Two species of green algae *Chlorococcum sp.* and *Desmococcus sp.* were collected from algal collection center, SRM University and *Spirulina sp.*, *Oscillatoria sp.* were collected from Livestock Research Station, TANUVAS. The algae were grown in 100 l capacity glass tanks using relevant media (*Chlorococcum sp.* and *Desmococcus sp.* in bold basal medium (1949), *Spirulina sp.* in Zaroucks medium (1966) and *Oscillatoria sp.* in BG11 medium). On 20th day, culture solution was siphoned into BOD bottles (300 ml) from each of the four algal species. Likewise one more set of bottles, black painted and wax coated was filled with 300 ml of culture solution from each of the four species. The dissolved oxygen concentration of the culture solution was measured involving modified Winkler procedure (APHA) and recorded as initial oxygen concentration (I) (Carpenter, 1965). The four light bottles and four dark bottles were incubated in the culture glass

tanks for one hour inside the closed room exposing to direct sunlight near a glass window. After incubation the light (L) and dark (D) bottles were taken out and the samples were analyzed for dissolved oxygen. The temperature of the water column was recorded at the start and stop of the incubation period. The experiment was carried out in triplicate series.

Results and Discussion

The dissolved oxygen concentration in the initial (I), light (L), and dark (D) bottle has an implicative meaning of carbon fixation and oxygen production of the algal species.

The dissolved oxygen production in the various bottles estimated is as follows:

Table 1: Dissolved oxygen concentrations of various bottles in ml/l.

Bottle	<i>Oscillatoria sp.</i>	<i>Spirulina sp.</i>	<i>Chlorococcum sp.</i>	<i>Desmococcus sp.</i>
Initial(IB)	4.5± 0.14	4.5 ± 0.14	3.2± 0.0	3.2 ± 0.0
Light(LB)	6.2± 0.14	5.65± 0.35	7.4± 0.28	5.25± 0.21
Dark(DB)	3.6± 0.0	2.65± 0.07	3.0± 0.14	2.35± 0.07

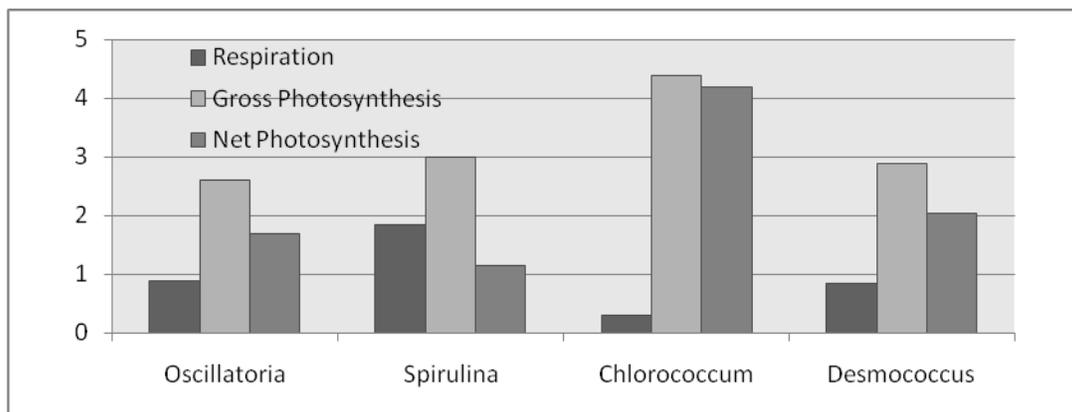
The results are indicative of a normal photosynthetic and respiratory behavior of aquatic plants. From this we could derive

Respiration = IB – DB

Gross Photosynthesis = LB – DB

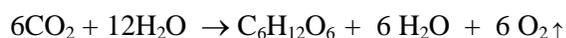
Net Photosynthesis = LB – IB

Fig 1: Comparison of respiration, gross photosynthesis and net photosynthesis (ml/l) among the four algal species.



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Converting the values of oxygen evolved into its carbon equivalents using the conventional stoichiometric formula on photosynthesis



It could be deduced that for every six oxygen molecules produced six carbon dioxide molecules are sequestered from atmosphere. For every 192 grams of oxygen produced 264 grams of carbon dioxide is abstracted.

The green algae, *Chlorococcum* could produce a maximum 4.2 ml/l or 6.02 mg/l (4.2/0.698) of oxygen (the cell count during this phenomenon happened to be 18×10^4 cell/ml) during day time per hour of light period. This alga could absorb 8.27 mg of carbon dioxide on active production for every hour, during day time. (For every 32 g of oxygen 44 g of CO₂ is absorbed. For 6.02 mg of oxygen production, 8.27 mg of Carbon dioxide is absorbed). Similarly, the amount of carbon di oxide absorbed for *Oscillatoria sp*, *Spirulina sp*, and *Desmococcus sp*. were 3.35 mg, 2.27 mg and 4.04 mg respectively. Literature illustrates that 5ml of oxygen is produced by an average leaf. A plant with 30 leaves can produce 150 ml of oxygen, hence 300 to 400 such plants produces 53 l of oxygen which is

required to keep a person alive for an hour (<http://www.newton.dep.anl.gov/newton/ask/asci/1993/biology/bio027.htm>). The results indicate that 64×10^6 cells of *chlorococcum sp*. has the ability to produce 150 ml of oxygen, it implies 2×10^{10} cells are required to produce 53 l of oxygen per hour. Erection of algal tanks with this culture in indoor environment would be sufficient to maintain the respiratory air balance resulting in the enhanced health of the human beings.

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