Photobioreactors for Indoor Air Purification

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INTRODUCTION

Figure 1 : Indoor air quality facts (González-Martín et al., 2021)

Indoor air pollution is caused by polluting fuels and technologies in and around indoor places, which can contain harmful pollutants. Monitoring and improving indoor air quality is crucial due to its potential health risks. Various mitigation strategies have been implemented to address indoor air pollution, including ensuring adequate ventilation, regularly maintaining heating and cooling systems, and utilizing air purifiers with HEPA filters. These efforts aim to safeguard human health by minimizing exposure to indoor pollutants.

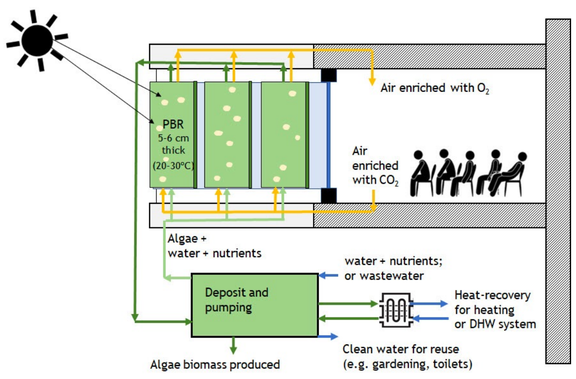

Figure 2 : Microalgae cultivation system integrated into a building as the proposed solution for indoor air treatment, showing the air flow in and out of a room (Mata et al., 2021).

Microalgae is a photosynthetic organism that can do carbon sequestration abilities, are also being explored for indoor air purification. Microalgae can be used to remove contaminants from indoor air, or even outdoor air, by removing contaminants and CO2 Microalgae have the potential to be a natural based solution for indoor air purification.

AIMS

- Determine the potential of microalgae to be an indoor air purificator.
- Build an indoor photobioreactor with microalgae.
- Study the social impact of the photobioreactor.

METHODS

PHOTOBIOREACTOR

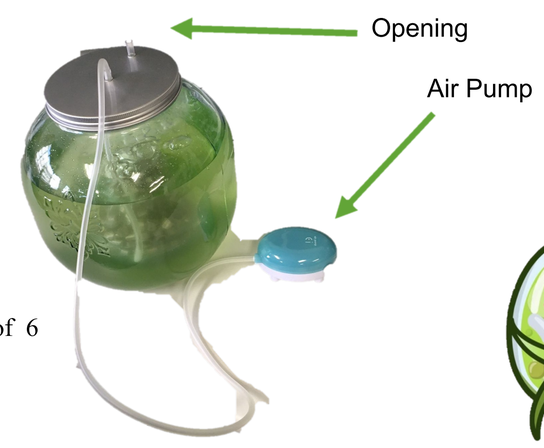

Figure 4:.
Photobioreactor of 6 Liters .

METHODS

STRAIN

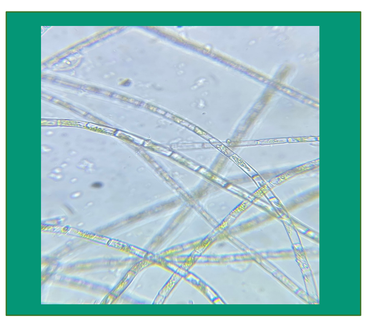

***Figure 5: Tribonema* sp**. 60X (Xanthophyceans, 2024)

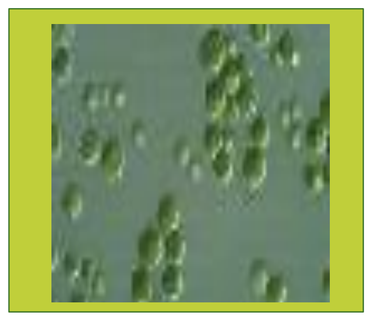

Figure 6: Chlorella vulgaris (NIES-642)

Figure 7: Collected the *Tribonema* sp. from the campus pound in July 2023.

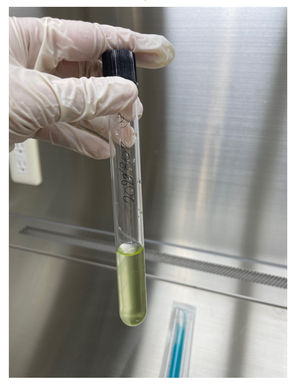

Figure 8: From NIES collection Microbial Culture Collection

Figure 9: Liquid fertilizer for grass.

Figure 10: Medium C from NIES

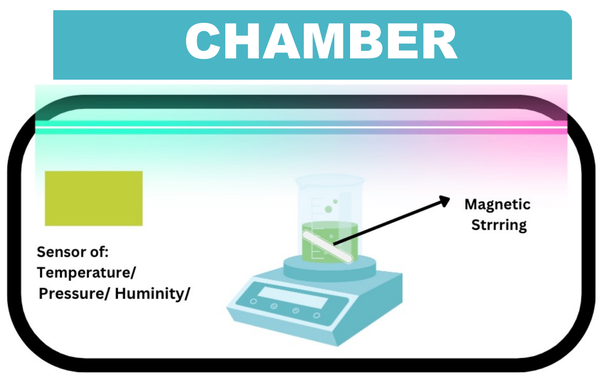

Figure 11: Chamber built at the lab

- Type equation here. 48-hour measurements
- Measurements inside and outside the chamber
- Sensor were built in the lab
- 300ml of medium
- Size of the chamber 59cm x 34cm x 28cm
- The change multiple of relative humidity and carbon dioxide:

$$\text{Multiple of change} = \frac{A_i}{A_0}$$

SURVEY

- Survey to understand the social impact of the photobioreactor in the students. (Hedge et al., 1996)
- Survey was sent to the students by email.
- 10 students answer

RESULTS

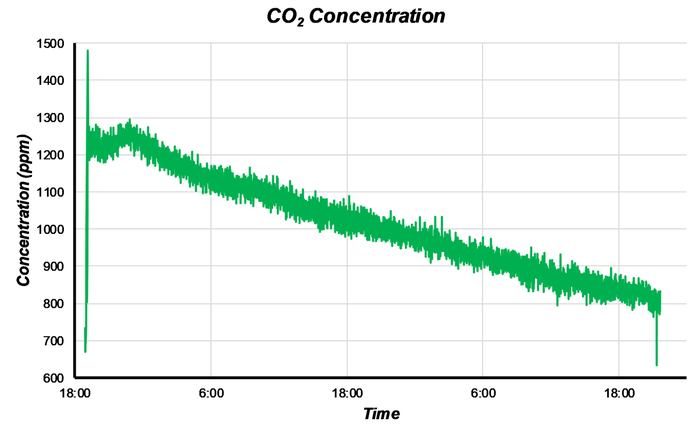

Figure 12: Graph of the measurements of CO2 of ***Chlorella vulgaris.***

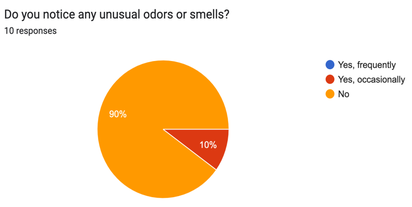

Figure 13: One of the results of the questions in the survey.

DISCUSSION

- **CO2 Absorption**: *Chlorella* microalgae showed the ability to absorb carbon dioxide (CO2) from the air (figure 12). This is beneficial for indoor environments where CO2 levels can rise due to human activity.
- **Humidity Regulation**: The evaporation and transpiration of the microalgae, can increase the relative humidity in the ambient air. In this case the microalgae relative humidity increase of 2.44 times in 48h. This can be helpful in maintaining comfortable indoor conditions, especially in dry climates.
- **Particle Aggregation**: If the relative humidity is more than 65% (which in this case was of 75%) it can cause fine particles, such as PM2.5 (particulate matter with a diameter of 2.5 micrometers or smaller), to aggregate into larger particles. This results in a decrease in the concentration of PM2.5, which is beneficial for air quality.
- **Acceptance by Office Users**: According to social acceptance studies, office workers or/ and students haven't noticed any significant issues with the bioreactor in terms of sound or smell (figure 13). However, they also haven't perceived any noticeable improvements in air quality.

FUTURE WORK

- Measure with *Tribonema* sp. in the chamber
- Measure the algae growth with a Secchi disk.
- Introduce the new equipment for measuring " CIS 9-in-1 Bluetooth Air Quality Monitor. Quality Monitor, CO2, HCHO, TVOC, PM2.5, PM1.0, PM10, Temperature and Humidity,
- Do chamber measurement with polluted air.
- Add the bio reactor to the chamber
- Measure the office environment with and without the bioreactor.
- In person or video survey.

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ACKNOLEDGMENT

- We want to acknowledge the support from the National Science Foundation for organizing this poster presentation (NSF Award No. 2401864). Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
- I want to thank Moji Purjam for being part of this research and doing a lot of the work .
- I want to thank my boyfriend, Julián Ortega-Durán, for encouraging me to apply for this program with the idea of this proposal.
- I would also like to thank Motaz Mabrouk for being part of this project.
- Dr. Takahiro Miyazaki for believing in this experiment, funding most of the instruments, and letting me use his lab. Dr. ITO, thank you for introducing me to the other lab and letting me use his lab.
- Also, thank you to Dr. Louime and Dr. Moreno for their letter of recommendation.
- My parents, Louis Gil and Myrna Acevedo, for all their support
- I would like to thank Bethany Hager for her advice on the social survey.