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Cultivation of green microalgae at the air

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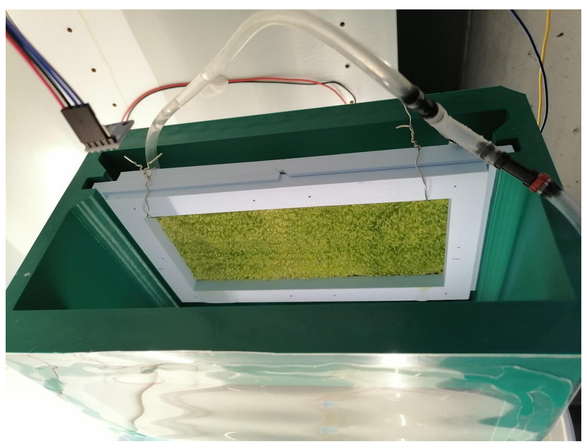
Introduction & Aim

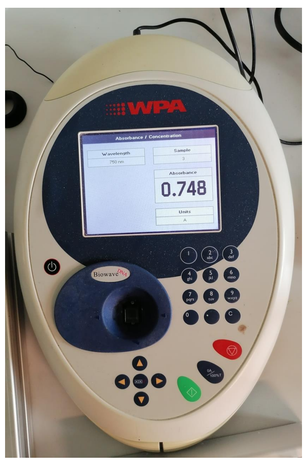
- Microalgae are cultivated for a broad range of applications, from food to cosmetics, from biofuel to biotechnology [1]
- While usually growing in suspension in bioreactors, this technique poses several challenges regarding processing, especially with respect to illumination and harvesting [2]
- Alternatively, some microalgae can be cultivated on suitable substrates in the form of a biofilm to solve the problem of harvesting; in this case, however, a constant and sufficient light intensity on the microalgae without overheating the medium is still problematic
- A previous project has thus investigated the possibility to let green microalgae grow on a suitable substrate outside a bioreactor, i.e. at the air, under regular wetting, which would improve illumination and ease harvesting [3]
- Here we report the growth of the green microalgae *Chlorella vulgaris* which is often used as dietary supplement or for cosmetics on textile substrates outside a bioreactor

Materials and Methods

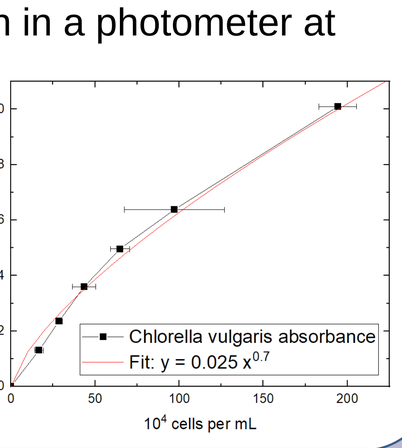
- Algae cultivation: *Chlorella vulgaris* in medium with 1 mL/L phytoplankton fertilizer “Planktino”
- Pre-cultivation in medium for 3 days
- Cultivation on textile fabric (Tencel plush) in beaker with medium for 6 days until algae were attached to the textile
- Constant fumigation and 8 h / 16 h artificial LED lighting
- Comparison of three different further ways of cultivation:
  - Cultivation on textile in a closed Petri dish
  - Cultivation on textile in the beaker (fumigated)
  - Cultivation at the air, dripping irrigation (dripping for 1 minute each 15 minutes)



- Cultivation for 7 days each, cutting samples of (4 cm)² from each textile substrate, placed in 20 mL water, detaching the algae from the substrate by an ultrasonic rod



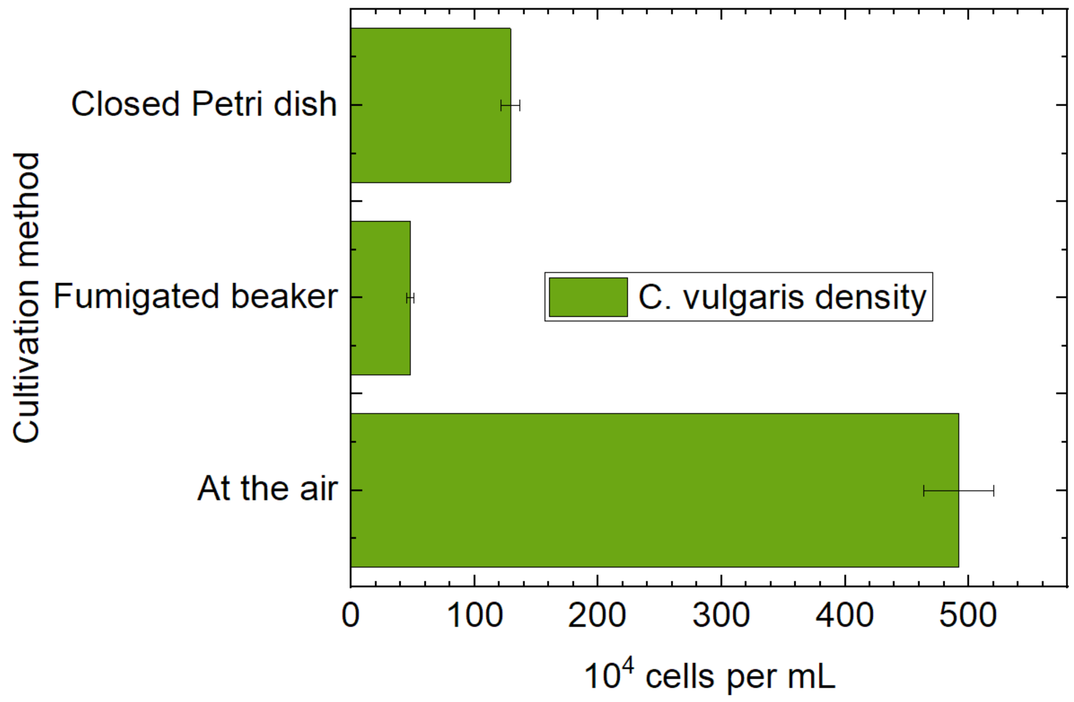
- Measuring the absorbance of the resulting solution in a photometer at 750 nm
- Evaluation of cell number according to nonlinear [4] calibration



Results

Algae growing well at the air:

Comparison of cell count with other experiments:



Discussion:
- Textile fabric too closely packed in the beaker
- Apparently no fumigation necessary in Petri dish
- Textile hold rigidly in air → easy to handle
- Algae not rinsed off by irrigation → uniformly growing

Literature

[1] Homburg, S.V.; Kruse, O.; Patel, A.V. Growth and photosynthetic activity of *Chlamydomonas reinhardtii* entrapped in lens-shaped silica hydrogels. *J. Biotechnol.* **2019**, *302*, 58-66.
[2] Lee, Y. K. Microalgal mass culture systems and methods: Their limitation and potential. *J. Appl. Phycol*. **2001**, *13*, 307-315.
[3] Steinmetz, P.; Diel, L.; Gehrmann, S.; Knehans, D.; Primandaru, G.; Tanzli, E.; Brockhagen, B.; Ehrmann, A. Growth of the green microalga *Chlorella vulgaris* outside a cultivation medium. *International Journal of Mechanics and Control* **2024**, *25*, 53-5.
[4] Hotos, G. N.; Avramidou, D.; Bekiari, V. Calibration Curves of Culture Density Assessed by Spectrophotometer for Three Microalgae (*Nephroselmis* sp., *Amphidinium carterae* and *Phormidium* sp.). *European Journal of Biology and Biotechnology* **2020**, *1*, 132.

Conclusion

- A previous setup for cultivation of green microalgae at the air was improved in terms of fixing the textile substrate, ensuring regular watering and increasing the available light on the substrates
- Our comparison between *C. vulgaris* grown on identical textile fabrics in a fumigated beaker, in a Petri dish and at the air show that the latter leads to a significantly higher microalgae growth than both more common methods, and that cultivation of microalgae at the air should thus be optimized further in future studies

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