**Lipid Production With *Microchloropsis Salina* in Open Thin-Layer Cascade Reactors at Mediterranean Climate Conditions.**

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**Highlights**

* Batch production of 6 g L-1 lipids in open thin-layer cascade reactors
* Accumulation of up to 46 % (w/w) lipids in *M. salina*
* Continuous production of 3.5 g L-1 lipids in a reactor cascade

**1. Introduction**

The utilization of sunlight and carbon dioxide for the production of energy-rich lipids by microalgae offers a possibility to produce renewable liquid fuels. Advances in biomass and lipid productivity are needed to become an economically feasible alternative to fossil fuels. Besides efficient downstream processing and catalysis, high product concentrations are essential to reduce the costs of biomass separation and drying. Because of the increasing light absorption in dense microalgae suspensions, high biomass concentrations can only be achieved in thin fluid layers.

**2. Methods**

Microalgae growth and lipid production of *Microchloropsis salina* was studied in artificial sea water [1] in open thin-layer cascade photobioreactors at pilot scale (A = 8 m2). For this purpose, the TUM AlgaeTec Center offers a realistic, dynamic simulation of light and climate conditions to evaluate microalgae processes at potentially suitable large-scale production sites [2]. The target climate of June 15, 2012 in Almería, Spain was physically simulated via an air conditioning system and a combination of natural sunlight and LED-based artificial sunlight. A nutrient limitation was used to induce the accumulation of lipids. Total lipid concentrations were measured via a Sulfo-Phospho-Vanillin assay [3].

**3. Results and discussion**

Biomass growth and lipid production of *M. salina* were studied in batch processes. At nutrient replete conditions a cell dry weight concentration above 40 g L-1 with a lipid content of 16 % was reached. At nutrient limited conditions lipids accumulated up to 46 % of dry weight while simultaneously reducing photosynthetic activity and biomass growth. Lipid concentrations of 6.6 g L-1 and an overall volumetric lipid productivity of 0.2 g L-1 d-1 were achieved after 30 days. Continuous production of lipids was achieved with a two-stage reactor cascade, spatially separating biomass growth and lipid accumulation. The reactor cascade reached a continuous production of up to 3.5 g L-1 lipids.

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**Figure 1.** A: Temperature profile of June 15, Almería, Spain (blue), physically simulated temperature in the TUM AlgaeTec Center (red) and water temperature in a thin-layer cascade reactor (black). B: Natural sunlight at TUM AlgaeTec Center on October 19, 2018 (red) and combination of natural and LED-based light (black). C, D: Cell dry weight and lipid concentration in batch processes with *M. salina* in an open thin-layer cascade reactor at physically simulated Mediterranean climate conditions. Blue: Nutrient repletion. Black: Nutrient limitation. Red: Nutrient limitation, doubled initial nutrient concentration

**4. Conclusions**

As is shown by these results, the continuous production of commodity chemicals and fuels from microalgal biomass remains a promising alternative to fossil resources. Further advances in process engineering as well as strain selection, downstream processing and catalysis are required to compete with petrochemical pathways.

**References**

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