PRODUCTION OF STABLE MICROALGAE-ENRICHED FOAM

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As an attempt for reducing costs of algae production processes, a liquid bed foam photobioreactor is being developed in the MIRACLES project, funded by the 7th Framework Programme. This innovative production system should lead to high biomass productivities by improving mass transfer and light use efficiency. Moreover, the dramatic reduction of water in the cultivation process also reduces harvesting costs through avoiding dewatering processes like centrifugation, filtration or flocculation. The aim of this work is to study the foam formation process in order to find out most promising microalgae strains, suitable foaming agents and optimal conditions to produce stable algae-rich foam.

This work includes the assessment of both natural and surfactant-mediated foaming capacities of several microalgae strains, as well as the algae up-drag ability and the stability of the foam produced. Assays were conducted with the microalgae species *Chlorella sorokiniana*, *Scenedesmus obliquus (CCFM)*, *Isochrysis galbana (T-iso, CCFM), Phaeodactylum tricornutum (CCFM), Nannochloropsis gaditana (CCFM)*, *Neochloris oleoabundans,* and *Botryococcus braunii*.

Regardless of the culture growth phase and biomass concentration, none of the algae strains tested produced substantial and stable foam naturally, meaning the addition of a foaming agent is required. BSA (bovine serum albumin) was used as surfactant to compare the influence of the different microalgae strains on foaming capacity. Most suitable BSA concentration to produce stable foam was determined for the different culture media employed. Foaming speeds were monitored and compared, as a function of culture growth phase and biomass concentration in the liquid medium. According to the obtained results, stationary phase of the selected microalgae cultures was discarded as starting point for addressing algae production processes in foam due to their limited productivity. Biomass pre-concentration resulted in slightly negative effects on foam production speeds. In terms of foam production speeds, best results were obtained with *C.sorokiniana, S. obliquus* and *N. gaditana.*

Algae hold-up abilities were also investigated. Preliminary assays showed pre-concentrated *Chlorella sorokiniana* cultures (D.W. ~10 $g \cdot L^{-1}$) to be very promising, yielding a hold-up higher than 100%. Differences in foam stabilities were also found depending on the strain. Salinity of the culture media employed showed that seawater-based media could produce more stable foams.

This study shows the potential of certain microalgae to be cultivated in foam. Optimization of operational conditions (foaming agent, cell concentration, among other factors) should lead to improved productivities and reduced operational costs. In this sense, foam-bed photobioreactors are proposed to be an innovative and more sustainable alternative for algal production.