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# Kinetic Modelling of Starch and Lipid Formation during Mixotrophic, Nutrient-limited Microalgal Growth

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## ABSTRACT

Microalgal starch and lipids, carbon-based storage molecules, are useful as potential biofuel feedstocks. In this work, cultivation strategies maximising starch and lipid formation were established by developing a multi-parameter kinetic model describing microalgal growth as well as starch and lipid formation, in conjunction with laboratory-scale experiments. Growth dynamics are driven by nitrogen-limited mixotrophic conditions, known to increase cellular starch and lipid contents whilst enhancing biomass growth. Model parameters were computed by fitting model outputs to a range of experimental datasets from batch cultures of *Chlamydomonas reinhardtii*. Predictive capabilities of the model were established against different experimental data. The model was subsequently used to compute optimal nutrient-based cultivation strategies in terms of initial nitrogen and carbon concentrations. Model-based optimal strategies yielded a significant increase of 261% for starch (0.065 gC $L^{-1}$) and 66% for lipid (0.08 gC $L^{-1}$) production compared to base-case conditions (0.018 gC $L^{-1}$ starch, 0.048 gC $L^{-1}$ lipids).

**Keywords:** Biofuels, microalgal dynamics, kinetic modelling, starch and lipids optimisation, *Chlamydomonas reinhardtii*