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# Ecophysiological modeling of the impact of light quantity and quality on microalgae growth in high-density open ponds

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## Abstract

Light is one of the main factors affecting the growth of phytoplankton, both at a quantitative level (total irradiance, usually measured by the photosynthetically active radiation or PAR) and at a qualitative level (spectral composition). In aquatic environment, both light quality and quantity vary through the water column, due to light attenuation by water molecules and suspended organic matter, including phytoplankton itself. This attenuation also affects the light quality since all the wavelengths are not attenuated in the same way. In open ponds dedicated to the production of high-density microalgal cultures, a similar process occurs but at a much shorter spatial scale (few cm). Although light is a crucial factor for improving microalgae cultivation techniques, studies dedicated to the impact of light quality on phytoplankton growth remain scarce. In this study, we perform experiments on *Dunaliella salina* cultures in open ponds (raceways) placed in a greenhouse. In order to estimate the impact of light quality on microalgal growth, the cultures were exposed to different light conditions using coloured filters. In parallel, we developed a growth model for microalgae cultivated at high density in open ponds. The originality of this model was to take into account both quantity and quality of incoming light. The experimental data were used to calibrate the model. For each spectral light condition, the model was able to reproduce the temporal evolution of algal biomass. The variability observed between the different light conditions was also reproduced. Our results show that the highest productions were reached in the open ponds with the strongest incoming light intensity. Moreover, the model predicted a better conversion yield of light energy under green light conditions. In the future, this model could be used to choose filters allowing an optimal growth of microalgae, to enhance the production of valuable chemical compounds.

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