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Calcified and naked coccolithophores respond differently to elevated light intensity

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Calcifying coccolithophores are ubiquitous marine phytoplankton that produce both organic carbon and inorganic carbon ($CaCO_3$), and thus play a crucial role in primary production and the global carbon cycle. The growth and calcification process of *Emiliania huxleyi*, a widespread coccolithophore species, is controlled by light availability. Whether coccoliths play a role in affecting the responses of coccolithophores to different light intensities remains unclear. In this study, *E. huxleyi* strains maintained at two different life stages (calcified RCC1216 and naked RCC1217) were selected to investigate their growth rates, photosynthetic parameters, and elemental stoichiometries under different light intensities. *Isochrysis galbana* (RCC1353), a microalga in the class *Prymnesiophyceae* with a close evolutionary relationship to *E. huxleyi*, was also chosen to examine its differential response compared to *E. huxleyi*. All microalgae exhibited a similar increase and subsequent decrease trend with elevated light intensity, but the naked *E. huxleyi* consistently showing a higher growth rate than the calcified *E. huxleyi*. The maximum yields of photochemistry of photosystem II (F_v/F_m) of naked *E. huxleyi* were also higher than that of calcified *E. huxleyi* under all light intensities investigated. Under higher light (150 μmol quanta m^{-2} s^{-1}), the F_v/F_m of both strains of *E. huxleyi* remained steady, whereas *I. galbana* displayed a sharper decrease in F_v/F_m. The higher half-saturated light intensity (I_k) and maximum electron transport rate (ETR_{max}) indicates that calcified *E. huxleyi* can withstand higher light intensity than naked *E. huxleyi*. The C and N content per cell of *I. galbana* exhibited a significant difference with elevated light intensity, while the C: N ratio did not change substantially. The different responses of *E. huxleyi* and *I. galbana* to light can be explained by comparative genomics. The metabolic mechanism of calcified and naked *E. huxleyi* under varying light intensities could be elucidated by proteomic analysis. This study provides a fundamental understanding of the distinct responses of calcified and naked coccolithophores to light enhancement in surface ocean and the impacts on the oceanic carbon cycle.