Chlamydomonas reinhardtii growth is accelerated by constitutive overexpression of a glutathione S-transferase

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A genetic mutant of the green alga *Chlamydomonas reinhardtii* that constitutively overexpresses cytosolic glutathione S-transferase (CC-4610; *GSTS1*) was investigated in comparison to wild type (CC-125) by a spectroscopic overview of their photosynthetic physiology. This overexpression results in several phenotypic changes, including a significant amplification to overall growth in photoautotrophic conditions (55% higher OD_{730} at the start of death phase). The breadth of changes to the photosynthetic electron transport chain visible in the genetic mutant indicate that implementation of GST overexpression in higher order plants may prove a succinct, efficient way of optimizing their growth. When compared to CC-125 by a battery of techniques *in vitro*, several of the phenotypic changes in CC-4610 mimic those of high-light grown green algae. Observation of Q_A^- reoxidation kinetics suggest that the mutant exhibits a higher reduction and turn-over of the plastoquinone pool, with a 13.1% larger population of reaction centers performing primary electron transfer to Q_B. CC-4610 also displays a markedly larger proton motive force than the wild type when monitored by electrochromic shift studies. Comparisons of fast repetition rate fluorometry, electrochromic band-shift, Q_A^- reoxidation kinetics, and quantum yields suggest an added mechanism of electrons being removed from the photosynthetic electron transport chain and subsequently shuttled to the mitochondria, amplifying respiration in CC-4610. These mechanisms may work in parallel to increase ATP availability and storage, respectively, contributing to the substantial increase in growth.