Species- and strain-specific gene expression of the prostaglandin pathway in *Skeletonema marinoi* and *Thalassiosira rotula*

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Abstract

Diatoms are critical to marine ecosystems, contributing to primary production and nutrient cycling. Prostaglandins (PGs), a group of bioactive lipid derivatives, are implicated in various cellular processes such as chemical signalling, stress response, and a plethora of other physiological processes. This study investigates the species- and strain-specific variability in prostaglandin biosynthesis gene expression in *Skeletonema marinoi* and *Thalassiosira rotula*, alongside strain-specific differences in oxylipin productivity. The research analyses four distinct strains—two low oxylipin-producing (FE60 and CCMP1018) and two high oxylipin-producing (FE7 and FE80)—across different growth phases and diel cycles. Gene expression was measured using RT-qPCR, targeting enzymes involved in prostaglandin synthesis. Cultures were sampled across exponential, stationary, and senescent phases, as well as under controlled light-dark cycles to capture diel variation. In parallel, a bioinformatic analysis expanded the current understanding of prostaglandin-related enzymes in diatoms by identifying both microsomal and cytosolic PGES non-homologous isofunctional enzymes, along with multiple PGFS candidates, like the putative CBR1-like enzymes, animal-related orthologs, and kinetoplastid-type PGFS. Notably, this work presents the first-ever characterisation of the prostaglandin biosynthetic pathway in freshwater diatoms, broadening the known distribution of these pathways beyond marine taxa. Results revealed significant strain-specific differences in the expression of key prostaglandin-related genes, particularly in response to light-dark transitions and across different phases of growth. These findings suggest that prostaglandin biosynthesis may be finely regulated by both genetic and environmental factors, influencing diatom physiology and ecological interactions. Furthermore, the results allow for speculation about a putative involvement of prostaglandins in programmed cell death (PCD) and cell duplication, drawing parallels to similar mechanisms in other organisms. The insights gained from this research enhance our understanding of the molecular mechanisms governing lipid derivative signalling in marine and freshwater diatoms, offering broader implications for their roles in chemical communication, cellular regulation, and environmental adaptation.