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Enhancing Algae Biofuels Phase II: Stress Analysis of ACCase, and Enzymatic Factor of Lipid Production

Algae biofuel holds great potential as a renewable energy source. Aiming to make algae fuels more feasible by improving oil yields, this long-term study determines how environmental stress impacts the molecular biology and enzymatic function of the algal lipid metabolism. It seeks to clarify the relationship between stress and growth, lipid accumulation, and transcription of acetyl coenzyme-A carboxylase (ACCase), a crucial enzyme in fatty acid synthesis, in the microalga Nannochloropsis salina. Based on previous research, it was hypothesized that nitrogen stress would affect the algal lipid metabolism by upregulating ACCase transcription to increase cellular lipid content while decreasing growth. N. salina was cultured in a homemade photobioreactor under a standard curve of nitrogen-stressed conditions. Concurrently, quantitative reverse transcriptase polymerase chain reaction (qRT-PCR) assay development was undertaken for original transcriptional analysis of ACCase. Cultures were analyzed with flow cytometry (FC) to fluorometrically measure growth and relative neutral lipid content and with gas chromatography (GC) to quantitatively assay total lipids. Novel primers for the ACCase gene in N. salina were designed from the newly sequenced Nannochloropsis genome to enable qRT-PCR analysis of ACCase transcription and tested for PCR/gel electrophoresis temperature gradient and qPCR serial dilution efficiency. FC and GC results trend that nitrogen limitation does decrease growth and increase cellular lipid content, though continued analysis is ongoing. Designed primers operate at almost 100% efficiency, demonstrating their ability to quantify ACCase transcript levels in continuing work and their value as an original and powerful tool in understanding and manipulating the algal lipid metabolism.