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Variation of fatty acid desaturation in response to different nitrate levels in *A enochlorella p renoido a*

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Microalgae are promising feedstocks for biodiesel, where the high proportion of monounsaturated fatty acid such as oleic acid (C18:1) is preferred. To regulate fatty acid desaturation in microalgae, the relationship among nitrate concentration, fatty acid composition and the expression levels of desaturase genes was explored. Dynamic variations of fatty acid profiles suggested nitrate could induce desaturation of C18 fatty acids. The content of C18:1 in *Auxenochlorella pyrenoidosa* was 30.88% at $0\ g\ l^{-1}$ nitrate concentration compared with 0.48% at $1.5\ g\ l^{-1}$. The expressions of relative delta-9, 12 and 15 fatty acid desaturase genes (Δ9, Δ12 and Δ15FADs) were further investigated. The 330% upregulated expression of Δ9FAD in logarithmic phase at $0\ g\ l^{-1}$ resulted in C18:1 accumulation. Moreover, nitrate replenishment caused a sharp reduction of C18:1 from 34.79% to 0.22% and downregulation of Δ9FAD expression to 1% of the nitrate absence level, indicating the pivotal role of Δ9FAD in C18:1 accumulation. Finally, overexpression of Δ9FAD in *Escherichia coli* and *Saccharomyces cerevisiae* resulted in an increase of C18:1, confirming its ability of desaturating C18:0. The results could provide a new approach and scientific guidance for the improvement of biodiesel quality and industrialization of high-valued chemicals by means of metabolic engineering.

1. Introduction

Globally, the air pollution and climate change caused by combustion of fossil fuel lead to increasing demands of the renewable and sustainable energy [1]. Microalgae biofuels such as methane, biodiesel and biohydrogen have attracted much attention [2]. The biodiesel derived from microalgae is biodegradable and non-toxic, deemed as the third generation

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