Fremyella Diplosiphon as a Biodiesel Agent: Identification of Fatty Acid Methyl Esters via Microwave-assisted Direct in Situ Transesterification

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Introduction

Increasing concerns on environmental and economic issues linked to fossil fuel use has driven great interest in cyanobacteria as third generation biofuel agents.

Results and Discussion

In this study, the biodiesel potential of a model photosynthetic cyanobacterium, *Fremyella diplosiphon*, was identified by fatty acid methyl esters (FAME) via direct transesterification. Total lipids in wild type (Fd33) and halotolerant (HSF33-1 and HSF33-2) strains determined by gravimetric analysis yielded 19% cellular dry weight (CDW) for HSF33-1 and 20% CDW for HSF33-2, which were comparable to Fd33 (18% CDW). Gas chromatography-mass spectrometry detected a high ratio of saturated to unsaturated FAMEs (2.48-2.61) in transesterified lipids, with methyl palmitate being the most abundant (C16:0). While theoretical biodiesel properties revealed high cetane number and oxidative stability, high cloud and pour point values indicated that fuel blending could be a viable approach. Significantly high FAME abundance in total transesterified lipids of HSF33-1 (40.2%) and HSF33-2 (69.9%) relative to Fd33 (25.4%) was identified using comprehensive two-dimensional gas chromatography coupled to time-of-flight mass spectrometry (**Fig. 1**), indicating that robust salt stress response corresponds to higher levels of extractable FAME. Alkanes, a key component in conventional fuels, were present in *F. diplosiphon* transesterified lipids across all strains confirming that natural synthesis of these hydrocarbons is not inhibited during biodiesel production. While analysis of photosynthetic pigments and phycobiliproteins did not reveal significant differences, FAME abundance varied significantly in wild type and halotolerant strains indicating that photosynthetic pathways are not the sole factors that determine fatty acid production. We characterize the potential of *F. diplosiphon* for biofuel production with FAME yields in halotolerant strains higher than the wild type with no loss in photosynthetic pigmentation.

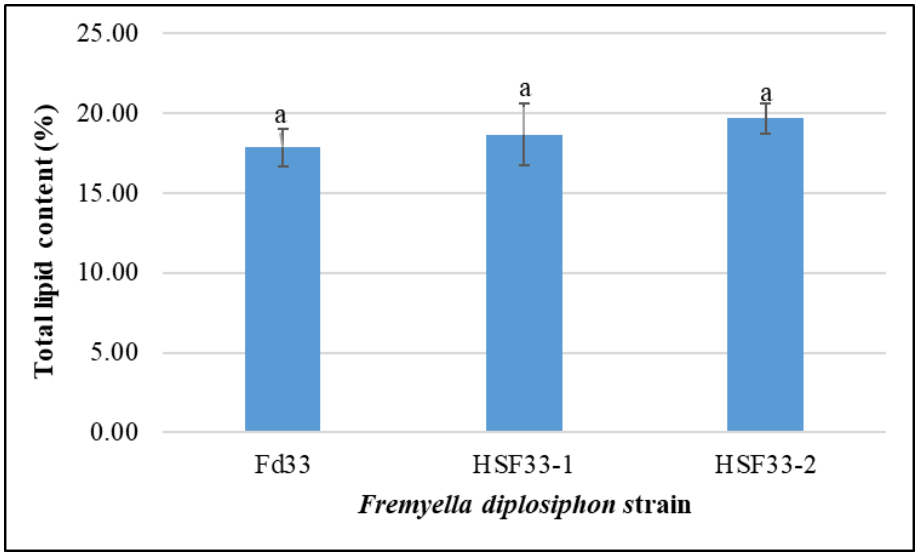

Fig 1: Comparison of total lipid content in wild type (Fd33) and transformant (HSF33-1 and HSF33-2) *Fremyella diplosiphon*. Average % lipid content (± standard error) for three biological replicates is shown for treatment. Data were analyzed using ANOVA tests to compare values for different strains. No significant difference was found ($p > 0.05$).

Acknowledgements

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References

[1] Tabatabai, B.*et al*., BioEnergy Research, **11**(3), 528-537 (2018)