

Enhancing lipid recovery from *Chlorella sorokiniana* through pretreatment and solvent optimization

M. Tsami¹, K. Fragkis¹, E. P. Kalogianni¹

¹ Department of Food Science and Technology, International Hellenic University, Thessaloniki, Greece

Corresponding author: mariatsami99@ihu.gr, elekalo@ihu.gr

Microalgae are increasingly recognized as a sustainable resource for food and biofuel production due to their ability to accumulate substantial lipid reserves. In this study, lipid extraction from *Chlorella sorokiniana* was investigated using hexane and ethyl acetate in different mixtures in the presence and absence of water. In addition, the effect of biomass pretreatment was examined using ultrasound and enzymes. For the enzymatic approach, mixtures of endo- β -1,4-xylanase and endo- β -1,4-mannanase were employed to facilitate cell wall degradation. Confocal microscopy was used to assess the extent of cell disruption. Both mechanical and enzymatic pretreatments enhanced lipid recovery compared to untreated samples, while solvent composition further affected extraction efficiency. Hexane extraction provided very low yields whereas ethyl acetate showed much higher recovery. The extraction efficiency increased with mixing both solvents optimizing the extraction of both the more and less polar fractions of lipids. Furthermore, the presence of water during ethyl acetate extraction resulted in emulsion formation, which hindered phase separation and negatively affected lipid recovery. These findings indicate that solvent optimization depends not only on solvent selection, but also on its composition and interactions with the biomass matrix. Overall, the results demonstrate that combining targeted pretreatment methods with carefully optimized solvent conditions can substantially improve lipid recovery from microalgal biomass, reinforcing its potential for sustainable bioproduct development.