# Effect of different solvent system on oil extraction from immobilized microalgae cells of *Chlorella vulgaris*: Kinetic and thermodynamic studies

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**Abstract:**
Microalgae as a feedstock for biodiesel production is gaining huge admiration among researchers recently however it is yet to be established well due to energy and cost consumption. Separation of microalgae from its growth medium is the real challenge before converting it into biofuel. Therefore, the current research focuses on immobilized microalgae cells of *Chlorella vulgaris* for oil extraction. Kinetic and thermodynamics of oil extraction were investigated using different types of solvent systems namely heptane, heptane: methanol, and heptane: ethanol. After the cultivation, the microalgae then separated using the immobilization method before harvesting it. The immobilized microalgae beads were then harvested into dried biomass and the oil was extracted by solvent extraction method using the solvents mentioned. The extracted oil was trans-esterified and analyzed for fatty acid methyl ester profile. Among the three solvent systems tested, heptane extracted the highest amount of oil from the immobilized microalgae which is 27.42 %. The extraction kinetics revealed that the reaction rate constant strongly depends on the temperature as the values increased with the increasing temperature. The activation energy of the oil extraction using heptane is determined to be 89.06 kJ/mol is the lowest among the solvent systems involved. The thermodynamic parameters were calculated to be $\Delta H$ = 0.111 kJ/mol, positive values for $\Delta S$, and negative values for $\Delta G$ for all conditions for the heptane system indicating the process was endothermic, irreversible, and thermodynamically spontaneous. Palmitic acid, stearic acid, oleic acid, linoleic acid, and linolenic acid were the major components identified in the oil extracted using heptane after all the oil tested for fatty acid methyl ester profile. Therefore, it can be concluded that heptane has a high potential to extract quality oil from immobilized microalgae cells of *C.vulgaris*.

**Keywords:** : *Chlorella vulgaris*; Immobilization; Solvent extraction; Solvent system; Kinetic; Thermodynamics

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