

Chemical Engineering Transactions

Response surface modelling and optimization of oleic acid yield from Sclerocarya birrea kernel oil in supercritical carbon dioxide extraction

Reddy, Trishen

Council for Scientific and Industrial Research (CSIR)

Meiring Naude Drive, Pretoria, 0184

Email: TReddy1@csir.co.za

This study investigated the potential for maximizing oleic acid (C18:1) yield from Sclerocarya birrea (Marula) kernel oil using supercritical carbon dioxide (CO₂) extraction. The investigation utilised a unique dataset comprising nine experimental runs derived from existing literature on Marula oil. Response Surface Methodology (RSM) was employed to evaluate the influence of the two primary independent variables viz. extraction pressure (varied between 250 bar and 450 bar) and extraction temperature (varied between 40 °C and 75 °C). During all runs, the CO₂ flow rate, extraction time, and particle size were held constant. A significant second-order polynomial model was developed to predict the yield of oleic acid. To achieve a practical and economically viable outcome, the Optimal (Custom) option within Design-Expert Version 13 software was specifically utilised to optimise the combined effects of temperature and pressure. This customized approach identified the most desirable set of operating conditions viz. temperature of 60 °C and pressure of 250 bar for achieving maximal oleic acid recovery, thus providing a foundational model for sustainable industrial applications.