

The use of response surface methodology as a statistical tool for the optimisation of the waste and pure canola oil biodegradation by Antarctic Soil bacteria

ABSTRACT

Hydrocarbons can cause pollution to Antarctic terrestrial and aquatic ecosystems, both through accidental release and the discharge of waste cooking oil in grey water. Such pollutants can persist for long periods in cold environments. The native microbial community may play a role in their biodegradation. In this study, using mixed native Antarctic bacterial communities, several environmental factors influencing biodegradation of waste canola oil (WCO) and pure canola oil (PCO) were optimised using established one-factor-at-a-time (OFAT) and response surface methodology (RSM) approaches. The factors include salinity, pH, type of nitrogen and concentration, temperature, yeast extract and initial substrate concentration in OFAT and only the significant factors proceeded for the statistical optimisation through RSM. High concentration of substrate targeted for degradation activity through RSM compared to OFAT method. As for the result, all factors were significant in PBD, while only 4 factors were significant in biodegradation of PCO (pH, nitrogen concentration, yeast extract and initial substrate concentration). Using OFAT, the most effective microbial community examined was able to degrade 94.42% and 86.83% (from an initial concentration of 0.5% (v/v)) of WCO and PCO, respectively, within 7 days. Using RSM, 94.99% and 79.77% degradation of WCO and PCO was achieved in 6 days. The significant interaction for the RSM in biodegradation activity between temperature and WCO concentration in WCO media were exhibited. Meanwhile, in biodegradation of PCO the significant factors were between (1) pH and PCO concentration, (2) nitrogen concentration and yeast extract, (3) nitrogen concentration and PCO concentration. The models for the RSM were validated for both WCO and PCO media and it showed no significant difference between experimental and predicted values. The efficiency of canola oil biodegradation achieved in this study provides support for the development of practical strategies for efficient bioremediation in the Antarctic environment.

Keyword: Waste canola oil; Pure canola oil; Antarctic bacterial consortium; One-factor-at-a-time; Response surface methodology