

## ABSTRACT

Rapid escalation in the energy demand and alarming greenhouse gas emissions have necessitated the adoption of renewable energy. In this context, biofuels are of prime interest since they are sustainable and eco-friendly. Therefore, in the present investigation, biodiesel production has been studied using oleaginous *Aspergillus awamori* and *Chlorella minutissima* MCC27. Industrial residues viz., leachate obtained from laccase treatment of *Ricinus communis* (ETBL) and crude glycerol have been used in the study. Further, De-Novo, Ex-Novo and their combined approaches have been explored for lipid accumulation in *Aspergillus awamori*. Considering the autotrophy and carbon sequestration potential of microalgae, lipid production from *Chlorella minutissima* has also been studied using modified airlift reactors with periodic converging-diverging geometry. One of the major bottlenecks of microalgal biodiesel is the costly harvesting step. Therefore, bioflocculation technique has been developed for harvesting *Chlorella minutissima* using *Aspergillus awamori*.

ETBL of *Ricinus communis* and crude glycerol were found to be potential sources for cultivation of *Aspergillus awamori* lipids with maximum lipid titer of 0.5 g/L and 1.65 g/L respectively i.e., lipid yield of 140 mg/g sugar and 127 mg/g free glycerol utilized. Combined De-Novo and Ex-Novo (CDE) mode of lipids production has been studied in *Aspergillus awamori* using food waste with maximum lipid titer of 1.4 g/L i.e., lipid yield of 0.107g/g total sugar and oil utilized. The uniqueness of CDE process is utilization of hydrophilic and hydrophobic substrates for lipid accumulation due to extracellular amylase and lipase secreted by *Aspergillus awamori*.

*Chlorella minutissima* MCC27, a potential oleaginous microalga has also been used in lipid production studies. To improve the volumetric mass transfer characteristics, periodic converging-diverging airlift reactor, one with internal and the other with external loop has been designed. An improvement of 1.12 and 1.39 folds in biomass titer has been observed with respect to uniform airlift and batch reactors respectively.

Bioflocculation technique has been developed for flocculating *Chlorella minutissima* using *Aspergillus awamori* with maximum flocculation efficiency of 93%. Quality of biodiesel produced from lipase mediated transesterification of *Aspergillus awamori*, *Chlorella minutissima* and co-culture lipids suggests that it is in conformance with IS, ASTM and EN standards.

**Keywords:** Biodiesel; De-novo and Ex-novo lipids, *Aspergillus awamori*, *Chlorella minutissima* MCC27, periodic converging-diverging airlift reactor, myco-phyco cultivation, lipase, transesterification.