ABSTRACT

Today, the world is faced with more challenges than one can count and it keeps increasing each passing day. Fuel crisis makes it to the top few on the list and to overcome that challenge, scientists have been carrying out research for a few decades now. Biodiesel is a great alternative to the conventional fossil fuel and has been proven so from time to time. But even to this day, using biodiesel by itself in an automobile engine is not feasible due to its instability and low performance characteristics in cooler regions. There are different ways to approach the production of biodiesel like using strong base or strong acid catalyst that were being used initially when biodiesel was in its primary days. This option gave good results, but proved to be toxic to the system, has issues with retrieving the catalyst and thus turned out to be very expensive. A new approach of using biocatalyst was further explored and lipases were the best options to break down TAG's present in oil lipids. Initially, commercially purified lipase enzymes from different algae were researched on and *Candida antarctica* (Novozym 435) was considered best in the lot. But, culturing the algae, lipase extraction, purification of lipase added extra cost on the final biodiesel product and thus made it a very expensive alternative. Alongside, a different approach of using whole-cell intracellular catalysts was being studied and *Rhizopus oryzae* IFO4697 was a very good option for biodiesel production. This particular study focuses on process optimization of producing biodiesel using refined soybean oil and methanol as substrates for transesterification reaction using *R. oryzae* whole-cell lipase as a catalyst for the reaction. Soybean oil was chosen primarily because of its abundance in the North American region and it is relatively cheaper. *R. oryzae* IFO4697 was chosen because prior research had proven its efficiency in catalyzing methanolysis reaction for other oils and the fact that we could use the cell directly into the reaction system, without lipase extraction or purification made it very cost effective. During the experiments, methanol: oil ratios were varied to study the effect of methanol on methyl ester yields, lipase concentration was a variable to know the minimum quantity of lipase required to achieve maximum methyl ester yields and *tert*-butanol was added to the reaction system to help make methanol more soluble and negate its effect on lipase activity. Hence, to study how efficiently butanol function, that was also a variable. The results showed that methanol at a molar ratio of 3:1 worked best for the system, lipase concentration of 13% gave the highest methyl ester yields and butanol did not produce the desired effect.