Name of the Scholar : **Veena Singh**

Name of the Supervisor : **Dr. Meryam Sardar**

Name of Department : **Department of Biosciences,**
Jamia Millia Islamia, New Delhi.

Title of Thesis : **Biocatalyst Engineering & Medium Engineering of enzyme catalyzed reactions**

Abstract

Biocatalyst engineering and Medium engineering are relevant techniques to improve the efficiency and stability of enzymes in low water systems. Enzyme catalysis in organic solvents is being increasingly used for a variety of applications. Of special interest are the cases in which the medium is predominantly non-aqueous and contains little water. A display of enzyme activity, even in anhydrous solvents (water less than 0.02% by vol.), reflects that the minimum necessity for water is for forming bonds with polar amino acids on the enzyme surface. The rigidity of enzyme structure at such low water content results in novel substrate specificities, pH memory and the possibility of techniques such as molecular imprinting. Lipases have been the most frequently used class of enzymes in biotechnology. These enzymes have been available commercially for many other industrial sectors predating advent of biotechnology. Lipases are also very versatile biocatalysts. These enzymes can catalyze hydrolysis, esterification, transesterification reactions. In case of oils/ fat, their regiospecificity with respect to the position of the ester group on the glycerol chain is of considerable importance. Both nonspecific lipases and 1,3 specific lipases are known. In the case of latter, the possibility of acyl migration exists. **Biodiesel** is a mixture of monoalkyl esters of fatty acids and is obtained by transesterification of oils/ fats. The transesterification can be catalyzed by either an acid or alkali or by an enzyme. When an enzyme is used as a catalyst, the reaction can be carried out at a moderate temperature; downstream processing is easier and if the feedstock oil

contains high FFA content, enzymatic process seems to be more robust to deal with it. Lipases have been used for this purpose and the process has been described with a very large number of oils and fats with varying degree of success. Transesterification reactions catalyzed by lipases are carried out in a low water media. Either one can use nearly anhydrous organic solvents as reaction medium or work with a solvent free media in which case substrates (oil and the alcohol) constitute the reaction medium. Biodiesel is considered as a promising biofuel for two main reasons. Firstly, the issue of energy security for individual nations. Secondly, the environmental concerns have motivated search for sustainable technology. **Reactive extraction** is an approach which integrates separation and reaction processes. This process intensification strategy aims at saving the cost of equipment, energy and other incidental expenditure involved in a separation process. Reactive extraction can involve liquid- liquid extraction or solid liquid extraction. Apart from the advantages mentioned above, this strategy also is beneficial in several cases for other different reasons. If the product being formed is unstable it can be continuously extracted. In bioprocess such as fermentation wherein product inhibition can lower productivity, removal of the product by continuous extraction can help. The oils used in the present work have been from **Castor seeds** (non edible oil source) and **spent coffee grounds** (waste material). Both “straight from the bottle” and modified formulations of lipases have been tried. Both biodiesel and biolubricants/biosurfactants have been prepared. The results of some efforts to use microwave assistance during transesterification reactions and esterification reactions have also been described.