



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

Name of the Student : PRITAM KUMAR DIKSHIT

Roll Number : 126107033

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Thesis Title: Bioconversion of Crude Glycerol to Dihydroxyacetone using Immobilized *Gluconobacter oxydans*: Process Design, Optimization and Intensification

Name of Thesis Supervisor(s) : Prof. V. S. Moholkar

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**SHORT ABSTRACT**

Conversion of biodiesel derived waste/crude glycerol to higher value products is a potential way for enhancing the economy of biodiesel industry. Among several products, dihydroxyacetone (DHA) is one of the fine chemicals known to be used in pharmaceuticals and cosmetics industry. The present thesis is focused on the production of DHA from crude glycerol using immobilized *Gluconoabcter oxydans* cells. The immobilization support, Polyurethane foam has highly porous structure with large surface area, and cells can easily get immobilized over the surface as well as inside the pores, which results in high cell density in relatively small volume. The thesis is divided in many sections. As reported earlier, high concentration of both substrate (i.e. glycerol) and product (i.e. DHA) can inhibit cell growth and DHA biosynthesis, leading to low DHA yield and productivity. We have addressed the matter of substrate and product inhibition of free and immobilized cells in presence of both pure and biodiesel-derived crude glycerol. The experimental data were fitted to various substrate inhibition model in order to calculate the kinetic parameters. In the second step, the optimization of medium components were done using Plackett-Burman and central composite experimental design method. Most significant factors were selected from Plackett-Burman design, which were further optimized using central composite design. In the next step, optimization of the process variables (pH, temperature and initial glycerol conc.) were carried out. The optimized medium and process variables were further used for carrying out the batch and repeated-batch experiments. Further the intensification of the crude glycerol fermentation was carried out using sonication. Both free and immobilized cells of *G. oxydans* have been used for fermentation. Application of sonication during fermentation was revealed to boost glycerol consumption rate. The circular dichroism analysis of intracellular proteins obtained from ultrasound-treated *G. oxydans* revealed significant reduction in  $\alpha$ -helix and  $\beta$ -sheet content. These conformational changes in protein structure were possibly induced by strong micro-convection generated by sonication, and could lead to augmentation of activity and substrate affinity of the intracellular enzyme glycerol dehydrogenase. This phenomenon is essentially manifested in terms of enhanced kinetics of glycerol fermentation by *G. oxydans*. So this thesis presents a complete conceptual lab scale process for synthesis of DHA through fermentation of crude glycerol.