Green Chemistry with Supercritical CO2 and Enzymes

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Green chemistry is a practice to develop sustainable ways to carry out chemical processes. “Greening” the chemical industry has a big impact in reducing pollution, lessening dependency on petroleum, and increasing safety and efficiency. We are exploring the use of supercritical carbon dioxide (CO2) and other plant-derived solvents as environmentally benign solvents in the place of toxic organic solvents derived from petroleum (e.g. hexane, toluene, and dichloromethane). We are investigating whether organic synthesis reactions catalyzed by enzymes can be carried out in these “green” alternative solvents. Enzymes are catalysts produced by a living organism, known for high efficiency and selectivity, and environmentally friendly. Enzymes usually only work in aqueous medium, within physiological temperature and pH range, and beyond that they usually denature. However, select immobilized enzymes are available commercially, and we are testing the scope and limitation of Novozym 435, an immobilized lipase in supercritical CO2 and other plant-derived solvents. The reactions that we are testing are asymmetric esterification catalyzed by Novozym 435 in tandem with a ruthenium-based alcohol racemization catalyst. This type of reaction, if works, is useful in synthesizing pharmaceuticals.