Biocatalytic synthesis of oxygenated biofuels through the technologies of ionic liquids and supercritical carbon dioxide.

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Thematic Areas: Biocatalysis

The increase in the production of biofuels has generated in the market an excess of glycerol as a by-product. Some glycerol derivatives, such as solketal (1,2-isopropylidene glycerol), have been used successfully to synthesize new oxygenated fuels, such as fatty acid solketal esters (FASE), in order to increase the octane number of the gasolines. Biodiesel exhibits an excellent suitability as a liquid fuel (adiabatic flame temperature, viscosity, etc.), blending up to 20% volume fraction of ASE.[1]

Through the use of immobilized lipases, the biocatalytic synthesis of oxygenated biofuels can be carried out, such as fatty acid solketal esters (FASE), either by direct esterification of fatty acids (lauric, palmitic, oleic acid, etc.) with solketal, or by transesterification of different esters (eg vinyl laurate) with the same alcohol. However, the direct use of the solketal produces a strong effect of deactivation of the enzyme, being convenient to make an adequate design of the medium and the reaction systems to mitigate the possible disadvantages and improve the biocatalytic application.[2]

In this sense, it is worth mentioning the hydrophobic ionic liquids (IL), based on cations with long alkyl side chains (*e.g* [C_{18}tma][NTf_2]), have been shown as an excellent reaction medium to produce FASEs, with yields close to 100 %.[3] Alternatively, biphasic systems based on the combination of IL (or the use of supported Ionic Liquid Phases, SILLPs) and supercritical carbon dioxide ($scCO_2$) are also suitable reaction medium to develop new green biocatalytic processes.[4]

This paper presents the design of a new continuous flow biocatalytic reactor, based on the C. antarctica lipase immobilized on SILLP particles, for the production of solketyl esters in supercritical conditions (Fig.1), capable of producing a product pure with yields close to 100%, and without loss of activity during continuous operation.

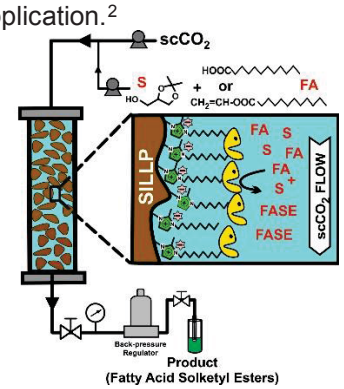

Fig.1. *Experimental set-up of the supercritical biocatalytic reactor.*

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