BIOTRANS
LA ROCHELLE 2023

N°875 / OC
TOPIC(s) : (Chemo)enzymatic strategies / Industrial biocatalysis

# Biocatalysis for the valorisation of food-processing waste: the case of soapstock from seed oil refining


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## PURPOSE OF THE ABSTRACT

According to the United Nations' Food and Agricultural Organization (FAO), global food production will rise by more than 70% by 2050 to feed 9.1 billion people. Since significant amounts of waste and byproducts are inevitably produced throughout the agri-food chain during the processing and transformation of the products, their disposal is expected to have an increasingly negative impact on the environment and the economy.

Therefore, the recovery and valorization of food waste are becoming key objectives in the framework of minimizing the environmental impact and improving the sustainability of the whole sector. We believe that, in this context, biocatalysis, relying on proteins purposely evolved to work with high efficiency on natural compounds, may play a major role in the transformation and valorization of many byproducts coming from the food industry.

In particular, in the latest years, we devoted our attention to the seed oil refining process where we were able to apply biocatalytic tools to different byproducts (gums, soapstock, spent bleaching earth) employed as raw materials for the synthesis of valuable molecules. In this presentation, we will focus on the chemo-enzymatic treatment of soapstock.

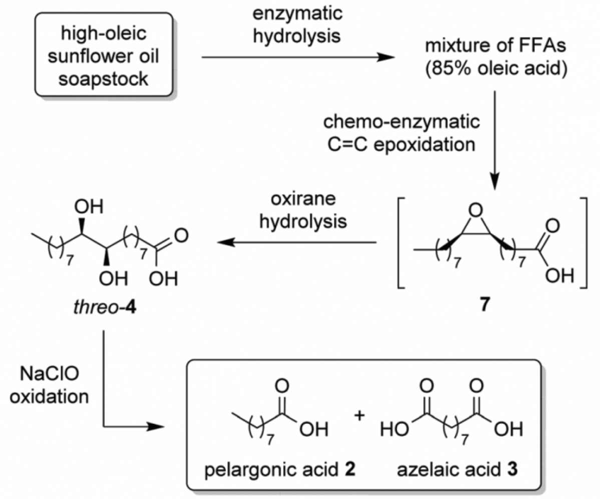
Soapstock is one of the most abundant by-products of vegetable oil refinement and consists of a sticky alkaline emulsion containing approximately 50% water, 10% sodium salts of fatty acids, 10% triglycerides and small percentages of partially hydrolyzed lipids. Herein we provide two examples where the relatively abundant oleic acid coming from HOSO (High Oleic sunflower Oil) soapstock was employed as the starting compound for the synthesis of valuable compounds.

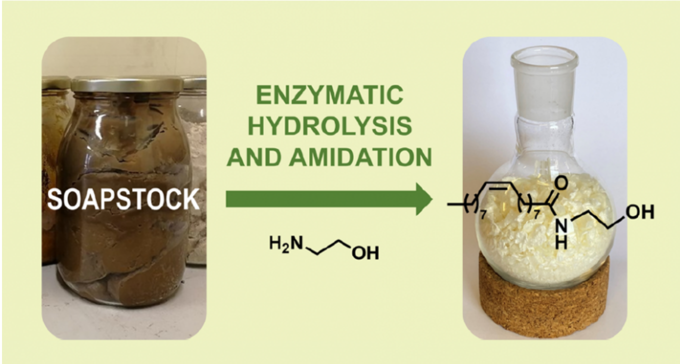
In both cases, the preliminary step was a lipase-mediated splitting of the soapstock affording a mixture of fatty acids (80-87% oleic acid). Then, this intermediate material was employed in two different syntheses.

1) In the first process, the self-epoxidation of oleic acid upon lipase-mediated perhydrolysis in the presence of hydrogen peroxide afforded the corresponding epoxide, which was subsequently hydrolyzed to the diol derivative and, finally, oxidized to commercially valuable azelaic and pelargonic acids (Figure 1). Epoxidation and glycol cleavage were optimized through a statistical approach and implemented under continuous-flow conditions to increase yields and productivity. [1,2]

2) In the second application, a lipase promoted the condensation of oleic acid with ethanolamine to provide the corresponding amide in good yield and excellent chemical purity (Figure 2). The use of a packed-bed reactor in continuous flow mode permitted to improve the spacetime yield of the reaction and the catalyst productivity. [3]

## FIGURES




### FIGURE 1
The first process

Chemo-enzymatic synthesis of azelaic and pelargonic acids from soapstock

### FIGURE 2
A second process

From soapstock to oleyl ethanolamide

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## KEYWORDS
Circular economy | Lipases | Epoxidation | Amidation


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