DESIGN OF CATALYTIC PROCESSES WITH DEEP-EUTECTIC-SOLVENTS (DECADES) DOCTORAL NETWORKS PROJECT

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The choice of solvents – as reaction media and for downstream processing – defines the overall sustainability of chemical transformations. So far, (bio)catalysis has traditionally relied on either aqueous- or classical organic media, or biphasic systems thereof. Selection of solvents has usually implied a case-by-case assessment for every system and step (reaction or purification), leading to several scientific and technological challenges untouched or unsolved. In this respect, Deep Eutectic Solvents (DESs) have been coined as 'the solvents of the 21st century'. In a nutshell, DESs' assets are based on the often biogenic origin of the components, and their properties such as melting points below room temperature, low volatility, high thermal stability, tunable properties depending on their components, biodegradability, large availability at acceptable costs, and straightforward preparation.

Horizon Europe Marie Skłodowska-Curie Actions doctoral networks programme DECADES seeks to become an inspirational lighthouse for the use of DESs as highly advantageous solvents to improve the sustainability of biotechnological processes. With a training focused on scientific excellence, creativity, innovation and entrepreneurship, DECADES aims for a solid employability of its PhD graduates as future technology leaders for a sustainable bioeconomy.

Objective 1: fit biocatalytic activity and stability for DESs in representative reactions in cell-free and cellular systems, all to high-value projects; but, posing different challenges, with a focus on (i) oxidase, (ii) dehydratase, (iii) decarboxylase, (iv) racemase, (v) dehydrogenase, (vi) hydrolase enzymes, and (vii) genome engineering.

Objective 2: gain knowledge on the effects of DESs on enzymes, on bio- and chemo-catalytic systems, and devise strategies for their optimization.

Objective 3: demonstrate the technology with the implementation of production routes of three target products (fine chemicals and bio-based products) and their purification in high yields, including (i) oligosaccharides, (ii) highly functionalized lignin-based phenolics, and (iii) unnatural α-amino acids.

Objective 4: exploit the solvent design and application considering catalyst design, substrate loading, environmental footprint, process design, and downstream processing in a holistic manner.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them. HORIZON-MSCA-DN-2021 I Grant no.: 101072731.