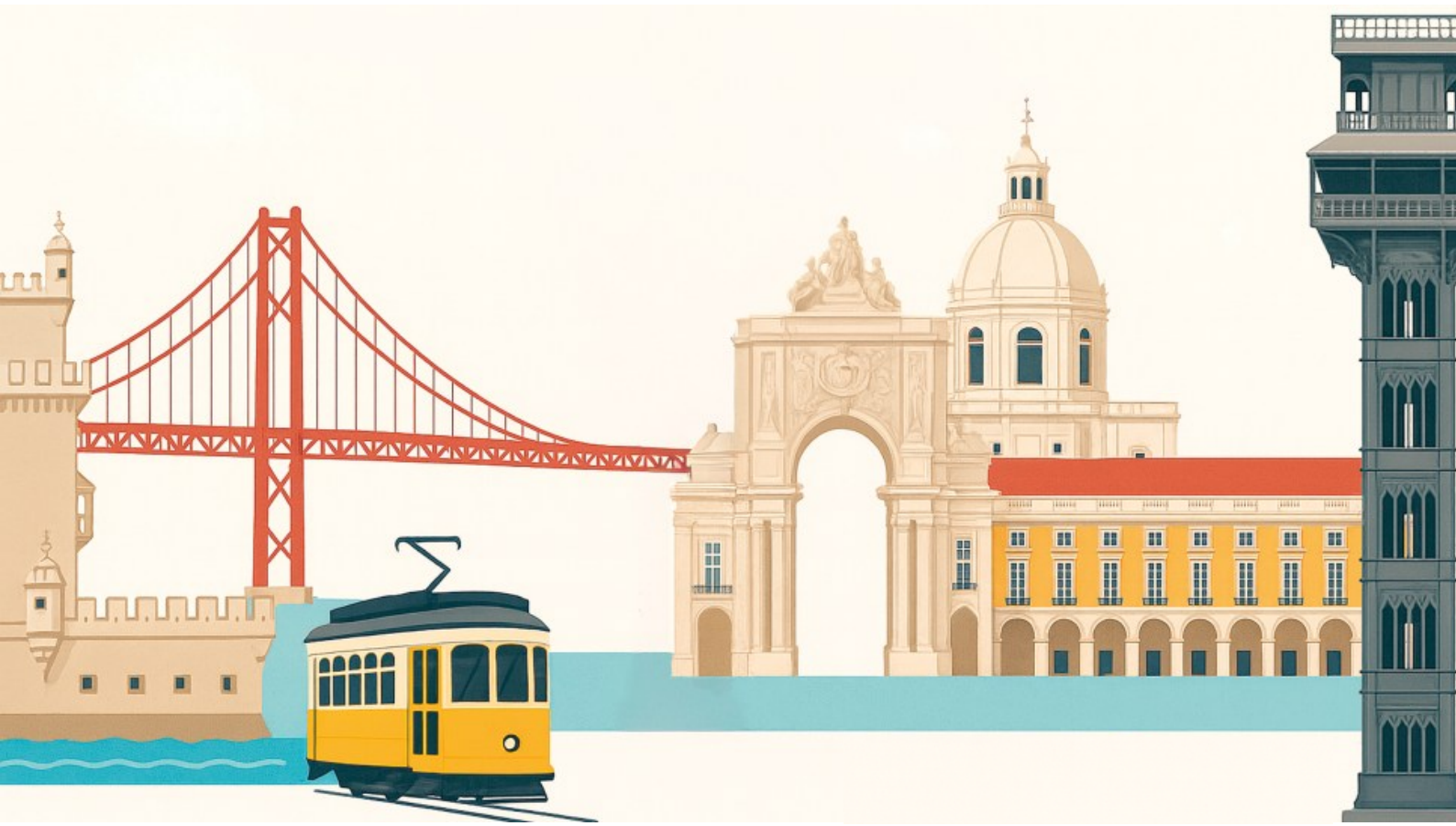

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P40 Integrated Valorization of Food Waste as Catalytic Supports and Feedstocks for Bio-Based Chemicals and Fuels

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Scientific topic: Synthesis of new catalysts, carbon materials or other porous materials

The growing need for sustainable aviation fuel (SAF) has intensified interest in renewable feedstocks capable of supplying both platform molecules and functional carbon-based materials. In this context, food waste residues represent an abundant, low-cost and underutilized biomass resource with significant potential for integrated biorefinery applications.[1] This work investigates the selection and pre-treatment of a range of food-derived residues, namely banana peel, spent coffee grounds, grape pomace, tomato pulp, orange peel, carrot peel, carrot pulp, apple pulp, pineapple peel, watermelon peel, onion peel and potato peel, for their subsequent use both as precursors for catalytic supports and as reaction substrates for producing furfural (FUR) and levulinic acid (LA), two key intermediates in the synthesis of advanced biofuels, including SAF.

A comparative assessment of two physical pre-treatment strategies, blending and ball-milling, was carried out in order to determine their influence on the properties and sugar composition of the selected residues. Untreated, blended and milled samples were dispersed in water and analyzed by high-performance liquid chromatography to evaluate the composition of soluble sugars and identify compositional changes induced by each pre-treatment route. These analyses provide insight into the accessibility and transformation of carbohydrate fractions, which are critical for downstream conversion into FUR and LA. In parallel, the residues were characterized by attenuated total reflectance Fourier transform infrared spectroscopy, thermogravimetry (TG) and scanning electron microscopy, enabling the correlation of chemical functionality, thermal behavior and morphological changes with biomass type. These results enabled the identification of residues with the most suitable features for catalytic and reaction applications. Furthermore, selected residues, specifically banana and orange peels, were used to synthesize carbonaceous materials via hydrothermal carbonization.[2] The resulting hydrochars were further activated to develop porosity and characterized by different techniques to assess their properties.

The results showed that blending and ball-milling affected the selected residues differently, leading to measurable changes in soluble sugar composition and in their properties. Banana and orange peels were identified as promising precursors for hydrochar production, highlighting the potential of selected food wastes for dual valorization as feedstocks and catalyst supports. Overall, this study provides a systematic comparison of food waste residues and pre-treatment methods, highlighting how biomass origin and processing route affect sugar release and carbon material formation. The findings contribute to the rational selection of food waste residues for dual valorization pathways, supporting the development of circular strategies for converting waste into catalytic materials and renewable chemical precursors for SAF production.

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