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P.I.6 — Development of fermentable streams from dehesa pruning residues for biotechnological production of sustainable aviation fuel precursors

A.D. Moreno[1*], C. Álvarez[1], I. Ballesteros[1], M.J. Negro[1], A. González[1], M.P. García-Aparicio[1]

1: Advanced Biofuels and Bioproducts Unit, Energy Department, CIEMAT, Madrid, Spain

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Poster Presentations #23

P.I.6 — Development of fermentable streams from dehesa pruning residues for biotechnological production of sustainable aviation fuel precursors

A.D. Moreno[1], C. Álvarez[1], I. Ballesteros[1], M.J. Negro[1], A. González[1], M.P. García-Aparicio[1]*

[1] Advanced Biofuels and Bioproducts Unit, Energy Department, CIEMAT, Madrid, Spain

**Correspondence: david.moreno@ciemat.es*

Keywords: *steam explosion; inhibitors; single cell oil; oleaginous yeast*

The decarbonization of the aviation sector requires sustainable alternatives to fossil-derived fuels, with microbial oils emerging as promising precursors for Sustainable Aviation Fuels (SAFs). Mediterranean dehesa systems generate large amounts of lignocellulosic pruning residues despite their potential as renewable feedstocks for integrated biorefineries. In this context, the BIODESOIL project aims to develop biotechnological strategies for converting these residues into microbial oils and high-value bioproducts. This study aimed to develop fermentable lignocellulosic streams from dehesa pruning residues through an integrated biomass preparation and pretreatment strategy, and to evaluate their suitability for microbial conversion using the oleaginous yeast *Rhodotorula toruloides*.

Biomass preparation, including milling and aqueous extraction, was combined with dilute acid-catalysed steam explosion (SE) to enhance biomass fractionation. Pretreated solids were enzymatically hydrolysed while pretreatment liquors were characterized for sugars, organic acids, phenolics and furans. The compatibility of the preferred pretreatment liquor with *R. toruloides* ATCC 204091 was evaluated by assessing cell viability, biomass formation, sugar utilization and detoxification capacity using untreated, different pretreatment liquor-to-medium ratios, and activated carbon-treated liquors.

Biomass preparation prior to SE significantly enhanced pretreatment efficiency, with aqueous extraction followed by SE at 190 °C providing the highest overall sugar recovery (≈ 45 g/100 g extracted biomass). Although pretreatment generated inhibitory compounds, *R. toruloides* maintained high cell viability (≈85–90%) in media containing up to 50% pretreatment liquor. Sequential sugar utilization was observed, with arabinose consumed after xylose depletion. Moreover, furfural was efficiently converted into furoic acid, demonstrating the yeast's intrinsic detoxification capacity. Among the cultivation conditions evaluated, a pretreatment liquor-to-medium ratio of 1:2 provided the most favourable biological performance, combining high cell viability with the highest biomass formation and enhanced carotenoid production. Although activated carbon efficiently reduced furans and phenolic compounds, the treated liquor supported lower biomass formation, suggesting that detoxification may also affect the nutritional quality of the fermentation stream.

Overall, these results demonstrate that integrating biomass preparation with SE pretreatment enables the generation of fermentable streams compatible with microbial conversion, supporting the valorisation of dehesa pruning residues as feedstocks for biotechnological production of sustainable aviation fuel precursors within an integrated biorefinery.

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