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Tapping new feedstocks for biological synthesis using electrochemical hydrogenations: production of adipic acid from lignin-derived phenols

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A sustainable circular economy requires linking different sectors and scales [1]. The sector of electric power production and storage and the sector of production of chemicals and fuels can be linked in electrobiorefineires [2]. A highly important role for electrosynthesis in electrobiorefinieres play electrochemical hydrogenations and hydrodeoxygenations [3]. Here we showcase an electrobiorefinery converting lignin-derived phenols into adipic acid (AA) that is established using an electrochemical hydrogenation step followed by a microbial cascade reaction [4]. The combined route resulted in a steady production of AA with an overall yield of 57% when an aromatic mixture resembling depolymerized lignin is used as feedstock.

[1] de Vasconcelos B.R., Lavoie J.M.. Recent advances in power-to-X technology for the production of fuels and chemicals. Front. Chem., 2019, 7: 392.

[2] Harnisch, F., Urban, C. (2018): Electrobiorefineries: Unlocking the synergy of electrochemical and microbial conversions Angew. Chem.-Int. Edit. 57 (32), 10016 - 10023 10.1002/anie.201711727.

[3] Harnisch, F., Chávez Morejón, M. (2021): Hydrogen from water is more than a fuel: Hydrogenations and hydrodeoxygenations for a biobased economy. Chem. Rec. 21 (9), 2277 - 2289 10.1002/tcr.202100034.

[4] Chávez Morejón, M., Franz, A., Karande, R., Harnisch, F. (2023): Integrated electrosynthesis and biosynthesis for the production of adipic acid from lignin-derived phenols. Green Chem. 25 (12), 4662 - 4666 10.1039/D3GC01105D.

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