

Semi-industrial cascade protocols for the valorization of agri-food waste: highly efficient extraction and conversion of residual biomass

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By-products and waste management has garnered significant attention in the agro-industrial sector due to current environmental concerns and increasing consumer focus on sustainability. Despite the plethora of publications addressing extraction protocols for primary and secondary metabolites from agri-food by-products, scalability is hindered by high costs and energy consumption [1]. We experimented with several enabling technologies for green-extraction and biomass processing including: ultrasound, microwaves, pulsed electric fields, hydrodynamic cavitation, supercritical fluids, subcritical water, mechanochemical and enzymatic methods [2, 3]. A new paradigm in biomass extraction involves continuous-flow processes achieved by integrating cavitation techniques (ultrasound or rotor/stator hydrodynamic cavitation) with pulsed electric fields (PEF). This scalable method exhibits outstanding productivity. In the case of economically significant natural matrices like grape by-products, we successfully scaled up the processes to a semi-industrial production [4, 5]. Furthermore, recognizing grape stalks as a valuable source of lignocellulosic material, we conducted ultrasound-assisted lignin extraction and flash microwave-assisted conversion of cellulose to levulinic acid [6]. The precipitated lignin underwent microwave-assisted alkaline oxidation, resulting in the production of long-chain fatty acids and long-chain hydrocarbons as the primary products. In contrast, direct oxidation of grape stalks yielded vanillin and syringaldehyde in moderate yields [7].

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Giancarlo Cravotto is Full Professor of Organic Chemistry and Deputy Director of the Department of Drug Science and Technology (University of Turin). He started his academic career after one year of experience at the Technische Universität Berlin and few years in the industry. His research activity in the field of enabling technologies and industrial process intensification is documented by more than 550 scientific peer-reviewed papers (H. Index 77, 26,700 citations - Google Scholar), 21 international patents and several book and book chapters. Non-conventional technologies applied from laboratory to semi-industrial scale include: ultrasound, hydrodynamic cavitation, high shear homogenizers, microwaves, radio frequencies, ohmic heating, pulsed electric fields, cold plasma, ball mills, extruders, subcritical water and supercritical fluid reactors and hybrid combinations. He is Editor-in-Chief of Processes (MDPI, Basel) and associate Editor or Editorial board member of several journals (by Springer Nature, Elsevier, De Gruyter, Frontiers etc.). Scientific Research Award 2018 "Organic Chemistry for the Environment, Energy and Nanosciences" by the Italian Chemical Society. International green extraction of natural products "GENP2018" Award "Innovation in Chemistry". Kurnakov gold/silver medal 2019 (Russian Academy of Science). Gold medal "E. Paternò" 2017-2020 by the Italian Chemical Society; International RoGuiltlessplastic 2023 Price "Emerging High Technologies 2nd Place".