Bioproduction of Next-Generation Fuels from Waste Streams: the butanol case

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Environmental, social, and political issues related to the use of fossil resources for production of fuels, energy, and chemicals are pressing issues for the switch from a fossil resource based economy to a renewable resource based economy. The increasing access to energy and commodities in the developed countries and in the emerging countries is making the switch even more pressing. As a consequence, sustainable supply of energy and commodities as well as the supply security and the price reduction of energy and commodities necessitate the development of alternative routes to the production of chemicals, fuels, and energy.

Second generation biofuels and bio-commodities (e.g. bio-plastics) can be produced according to biorefinery processes applied to lignocellulosic residue/wastes used as feedstock. The industrial success of sugar-based biorefinery depends on several issues. These issues include the optimization of biomass preteatment and hydrolysis to provide cellulose/hemicellulose conversion, high sugar concentration in the solution to be delivered to the fermentation step, low content of fermentation inhibitors and energetic cost saving. The use of residue/waste biomass (e.g. agricultural residues and industrial agro-food wastes) asks for re-thinking the pretreatment process typically optimized for the delignification of dedicated crops and wood biomass used as feedstock for the production of first-generation biofuels. The wide spectrum of waste biomass composition provides numerous feedstocks characterized by low (12-25%) lignin content, potential candidates for the development of mild/low energy consuming pretreatment. Moreover, a further advantage of mild pretreatments is the production of fermentation inhibitors compounds – if any - at low concentration.

The optimal exploitation of waste streams must include the composition, the availability rate, the seasonal fluctuation, the waste/residue distribution on the country. The composition in terms of sugar polymers (cellulose and hemicellulose), lipids, proteins, and high-value species is the basic characterization to assess the potential exploitation of lignocellulosic biomass. The recovery of each component requires a series of operations (biorefinery). The footprint of each step of the exploitation process – in terms of energy, water, carbon, solvents, etc. – can be as remarkable as to dissolve the advantage of the waste exploitation. As a simple example, the energy required for sugar-polymer recovery from lignocellulosic biomass for biofuel production increases with the lignin content. The energy required to produce biofuels may become larger than the energy content of the produced biofuels.

The present contribution reports an example of route to produce biofuels from waste streams: biobutanol via biotechnological route by exploitation of agro-food wastes. The potential benefits of energy vectors production according to this route will be presented. The critical issues as regard the sustainability of the route will be discussed.