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Opinion

Microbial Solutions to Recover Waste through a Regenerative Approach

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Before waste covers the world, it's still some chance of recovering them through a regenerative approach. Every year, billion tons of waste are produced, of which about 40% are represented by paper and food scraps while about 20% are consists of plastic that inevitably enter the environment [1,2]. Organic biomasses from waste, agri-food and industrial by-products deriving from human activities can represent a significative nutritional resource for the different microbial metabolic activities. The organic C contained in the biomass represents the common denominator for the implementation of several possible microbial biosystems from which to obtain biofuel, building blocks and biochemicals at low costs.

In the last decade, many studies have focused on the implementation and optimization of technological and biotechnological processes aimed at the production of bioenergy and biochemicals [3]. Particular attention has been given to the second-generation biofuel, carboxylic acids and biopolymers production from lignocellulosic biomass. Some fundamental problems can be solved in order to make these biotechnologies truly valid and feasible on large scale, through the improvement of the biosynthesis and efficacy of the enzymes required in the saccharification phase [4,5] as well as the reduction of the inhibiting substances that remain after the pretreatment of plant material. Moreover, the identification and selection of the new type of bacterial strains also genetically modified for hyperproduction of enzymes [6,7] and/or able to resist the inhibitors, is necessary to maximize the synthesis of fermentation products [8,9].

Another problem that is substantial and not easy to solve is the supply of lignocellulosic biomasses that must be in sufficient quantity to feed the plants and guarantee the continuity and sustainability of the energy and biochemicals production. Surely the use of urban organic waste and/or agro-industrial by-products [10,11] could solve the problem of supply but the use of such typology of biomass requires more research in this field that can overcome the problems related to physico-chemical and microbiological heterogeneity of these biomasses.

New generation biotechnologies are opening alternative ways to achieve these goals through the meta-analysis of natural ecosystems [12], genetically engineered microorganisms, synthetic biology and biochemistry [13]. However it is essential take a multidisciplinary approach, by integrating biotechnologies with the identification of the best process configuration and optimization of the operational parameters [14]. In this way the recalcitrance of conversion, the low efficiency and the paucity of endogenous metabolic pathways could be overcome to ensure the production of higher yield of energy and biomaterials [15].

This aspect is very important, above all if the ambitious objective that it's arises is that of the progressive substitution of plastics deriving from the fossil fuels with bio-based plastics, biodegradable and compostable deriving from non-food renewable sources.

The waste hierarchy put organic fractions at the top to giving emphasis on eco-design of sustainable biopolymers and biofuel production via microbial bio-based process, for a new industrial revolution necessary to make the transition towards a circular economic model.

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