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Emerging microorganisms that value industrial liquid waste and promote the circular economy

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Introduction

The composition of the industrial wastewater produced depends on the raw material processed. Commonly, these wastes have high concentrations of suspended solids (SS) that vary between 5,000 to 40,000 mg/SSV and are composed on average of 72% protein, 21% fat and 7% carbohydrates, as well as a high organic load (300-6,300 mg/L) comprising significant concentrations of dilute protein and ammoniacal nitrogen. The vast majority of this liquid waste (close to 80%) is thrown into various bodies of water, generating pollution problems for the human communities that need to use said resource and in the same way causing a negative impact on the species of fish and organisms that inhabit these aquaculture bodies and that fulfill regulatory functions within the ecosystem.

Based on the above, during the last 30 years the use of environmental biotechnology applications has emerged with considerable force to bioremediate processes (decontaminate), generate new products from specific microorganisms (bioproducts) and, more recently, to value waste that they can potentially be reused as raw material or as part of some stage of the production process without generating final waste (circular economy, CE). In relation to the concept of CE, the use of microalgae with its biorefinery processes has advanced significantly and today they are widely used in advanced countries to obtain value-added products. However, there is also a group of marine protists that are gaining ground given their high biomass production and their diversity of commercially important metabolites (fatty acids, lipids, pigments, and enzymes), and these are the thraustochytrids (THs). THs are known to contain a high cellular content of omega-3 (ω3) long-chain polyunsaturated fatty acids (LC-PUFAs), such as eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid (DPA), which are important in the treatment and prevention of inflammatory and cardiovascular diseases, also having various applications in human and animal nutrition as food supplements.[1,2] In this sense, the use of wastewater as a substrate for the cultivation of THs has been studied by Fan et al.[3] where they detected a decrease in the organic load (chemical oxygen demand, COD) in the okara residue (residue from soy milk production), in Shochu (residue from Japanese alcoholic beverage),[4] with coconut water[5] and crude glycerol was also used, with which biodiesel was obtained.[6] Similarly, studies in the treatment of liquid waste from the potato chips industry, in the manufacture of beer and in the lupine protein extraction process[7] demonstrated that THs generate values of DHA and EPA concentration above 40% and 10% respectively in dry weight, being an interesting alternative to omega-3 for use in pet food for example.

However, most interesting of all is the fact that the biomass enriched with LC-PUFAs from THs could be used to be added as raw material at the beginning of a production process[8,9] or also be used as a by-product in other processes that require enrichment with LC-PUFAs or other metabolites that THs produce (for example, astaxanthin). This is where the use of THs enriched biomass plays an important role in the CE, since it is well known that all processes generate waste, however, when using THs crops with various residual sources (liquid and solid as well), have the option of incorporating this microbial biomass into the processes, thus avoiding having to dispose of the waste or treat it at the cost that this entails. Therefore, the benefit generated by these microorganisms is to be able to use waste that contains added value and that will not generate a pollution problem, since they close the cycle by avoiding discharges to water sources that could potentially present complex chemical compounds. In this way, the contribution to take advantage of waste that THs make goes hand in hand with the growing application that is being made today of the CE at the level of production processes.

Acknowledgments

None.

Conflict of interest

None.

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