Yarrowia lipolytica as a microbial host for flavors and fragrances production

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Thematic Areas: Food Biotechnology.

Abstract: Flavors and fragrances constitute a large part of the market of natural products and they represent a wide variety of chemical groups including ketones, aldehydes, alcohols, carboxylic acids, esters, lactones and terpenoids[1]. This class of compounds is widely used in the food, cosmetic, pharmaceutical and chemical sectors, and constitutes platforms to manufacture everyday life items. More than a quarter of the world market for food additives is represented by the flavor market[1] and it is expected that in 2020 its market will be close to $ 15.1 billion[2]. However, the demand of consumers for flavors and fragrances produced by natural means has led to a decrease of natural resources used for this purpose, being of great importance the development of biotechnological processes that meet consumer needs. Biotechnological production arises as an interesting alternative for its production, since the products obtained are labelled as “natural”.
Yarrowia lipolytica is a non-conventional and strictly aerobic yeast, with GRAS status, with many biotechnological applications due to the wide range of substrates that can use as carbon source and the ability to produce a large variety of metabolites with industrial interest. This yeast has been proved to be a robust cell for the biotechnological production of compounds that can be used as additives in food industry, such as organic acids, enzymes, biosurfactants, sweeteners and aroma and fragrances compounds[3].
γ-Decalactone (GDL) is a peach-like aroma widely used in many industrial applications and *Y. lipolytica* is able to produce it by biotransformation of ricinoleic acid, the main constituent of castor oil. The production of GDL has been intensively studied in order to better understand all process and optimize it. The role of lipases in substrate hydrolysis, the effect of substrate concentration, dissolved oxygen concentration and different fermentation strategies - batch and step-wise fed-batch – and bioreactor designs (STR and airlift) in the GDL production was investigated[4]. The characterization of GDL production by genetic modified strains at lab-scale bioreactor was also performed.
The potential of *Y. lipolytica* to produce other flavors and fragrances were also explored. 2-Phenylethanol (2-PE) is an aromatic alcohol with a fresh rose scent, and can be synthesized in yeast through shikimate and Ehrlich pathways. Either way, the main bottleneck for 2-PE production is its toxicity due to the fact that concentrations between 2 and 3 g L^{-1} inhibit the cellular growth[5]. Among several microorganisms able to produce 2-PE, *Y. lipolytica* appears to be promising due to its interesting characteristics, such as the Crabtree negative trait. Based on this, different strategies have been explored in order to improve 2-PE productivity combining strain selection, medium composition, culture condition optimization and application of *in situ* product removal techniques (ISPR).
New insights on the biotechnological production of GDL and 2-PE were achieved contributing with some different strategies to increase the flavors production, and a maximum GDL and 2-PE concentrations of 7 g L^{-1} and 2 g L^{-1}, respectively, were achieved.

Acknowledgements: This study was supported by the Portuguese Foundation for Science and Technology (FCT) under the scope of the strategic funding of UID/BIO/04469/2019 unit and of the project TUBITAK/0009/2014 and by BioTecNorte operation (NORTE-01-0145-FEDER-000004) funded by the European Regional Development Fund under the scope of Norte2020 - Programa Operacional Regional do Norte.

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