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Title:

Towards a cost-effective bioethanol process: yeast development to overcome challenges derived from lignocellulosic processing

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Abstract:

The use of renewable biomass to supply the increasing energetic needs and to partially replace fossil fuels is nowadays recognized as a suitable and desirable alternative to attain a sustainable growth based on a bioeconomy. In spite of the intensive research on lignocellulose-to-ethanol production processes, second generation (2G) bioethanol is still not cost competitive and specific challenges remain. These processes are as a whole substantially more complex than initially thought as several types of biomass may be used as substrate, each with specific challenges. A range of biomass pre-treatments may be applied for biomass fractionation, each with its own specificities and leading to different inhibitor profiles. Finally, different hydrolysis/fermentation schemes may be used. The optimization of these processes has to consider the integration of all the stages of the process and should be done together. One of the key aspects for the development of cost-effective lignocellulose-to-bioethanol processes is the engineering of the yeast strain. There is still a lack of robust and sugars-fast fermentation yeast strains for 2G bioethanol. Recently, we have screened and selected naturally robust yeast strains from industrial environments[1] and engineering some of the more promising strains with the xylose metabolic pathway[2] and inhibitor tolerance genes[3].

We will present the results of the simultaneous engineering of xylose metabolization pathway together with inhibitor tolerance in diverse robust background strains and its performance in different hydrolysates obtained from distinct types of biomass. The heterogeneous outcome of the genetic engineering in different hydrolysates show that tolerance and xylose engineering must be customized to the strain background and hydrolysate used in the process. The results obtained highlight that yeast development must not only be integrated in the process but it must also be tailor-made for each specific process.

[1]Pereira et al.(2014)Bioresource Technology 161:192-199.
[2]Romani et al.(2015)Bioresource Technology 179:150-158.
[3]Cunha et al.(2015)Bioresource Technology 191:7-16.