Ethylene glycol metabolism in the oleaginous yeast *Rhodotorula toruloides*

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Abstract:

The agro-food chain produces an impressive amount of waste, which includes not only lignocellulosic biomass, but also plastic, used for both protective films and packaging. Thanks to advances in enzymatic hydrolysis, it is now possible to imagine an upcycling that valorizes each waste through microbial fermentation. With this goal in mind, we first explored the ability of the oleaginous red yeast *Rhodotorula toruloides* to catabolize ethylene glycol (EG), obtained by the hydrolysis of polyethylene terephthalate (PET), in the presence of glucose in batch bioreactor experiments. Secondly, we focused on the physiology of EG catabolism in the presence of xylose or no other sugar as a carbon source.

Our results show that EG is metabolized to glycolic acid (GA) in all tested conditions. Remarkably, we report for the first time that the consumption of EG improves xylose bioprocess, possibly alleviating a cofactor imbalance by regenerating NAD(P)H. Consumption of EG in the presence of glucose started after the onset of the nitrogen limitation phase, and no significant differences were observed with the control; a 100% mol mol^{-1} yield of GA was obtained, which has never been reported for yeasts. Finally, a putative pathway was proposed by *in silico* analyses supported with the existing omics data.

Our results propose *R. toruloides* as a promising candidate for the production of GA from EG that could be exploited simultaneously for the sustainable production of microbial oils from residual hemicellulosic biomasses.