

Adaptation of yeasts to fructose rich environments: a role for horizontal gene transfer of a fructose transporter

Carla Gonçalves¹, Marco A. Coelho¹, Madalena Salema-Oom^{1,2}, Paula Gonçalves¹

¹ UCIBIO, REQUIMTE, Departamento de Ciências da Vida, Faculdade de Ciências e Tecnologia, UNL, 2829-516 Caparica, Portugal

² Instituto Superior Ciências da Saúde Egas Moniz, Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Caparica, Portugal

Contrary to other hexoses like galactose or mannose, fructose enters the glycolytic pathway as readily as glucose, and from that point on their metabolisms are undistinguishable. A preference for glucose as carbon and energy source seems to be widespread in the Saccharomycotina sub-phyllum. Hence, the preference for fructose over glucose usually referred to as fructophily, is rather uncommon. Until now it was only identified in a handful of species confined to the *Zygosaccharomyces* genus and the distantly related *Wickerhamiella/Starmerella* (W/S) clade that encompasses species associated with the fructose-rich floricolous niche [1]. In *Z. rouxii* fructophily seems to be strongly linked to the presence of a special type of fructose transporter, Ffz1 [2], while outside this clade the molecular requirements remain to be fully elucidated. To gain insight in the evolutionary origins of fructophily, we sequenced the genomes of four species belonging to the early divergent W/S clade and identified *FFZ1* sequences in all species. Ffz1 is only distantly related to other sugar transporters, being instead very closely related to drug-proton antiporters [3], raising the question of how and when it evolved. The identification and functional characterization of putative Ffz1 homologues from both the Pezizomycotina and the Basidiomycota, brought to light a patchy distribution of the gene driven both by complex patterns of gene losses and duplications, as well as horizontal gene transfer (HGT) events. Importantly, our results suggest that the gene was acquired by yeasts through HGT and that the current biochemical properties of Ffz1 are the result of a gradual process of evolution, of which it was possible to retrace some steps.

[1] Kurtzman, C. P., Fell, J. W., Boekhout, T. 2011. *The Yeasts: A taxonomic study* Fifth Edition. Elsevier

[2] Leandro, M. J., Cabral, S., Prista, C., Loureiro-Dias, M. C., Sychrová, H. 2014. The high-capacity specific fructose facilitator ZrFfz1 is essential for the fructophilic behavior of *Zygosaccharomyces rouxii* CBS 732T. *Eukaryot. Cell* 11: 1371-1379

[3] Leandro, M.J., Sychrová, H., Prista C., Loureiro-Dias, M.C. 2010. The osmotolerant fructophilic yeast *Zygosaccharomyces rouxii* employs two plasma-membrane fructose uptake systems belonging to a new family of yeast sugar transporters. *Microbiology* 157:601-608

Consider for oral presentation