Tools development for the recycling of lignocellulosic biomass in yeast

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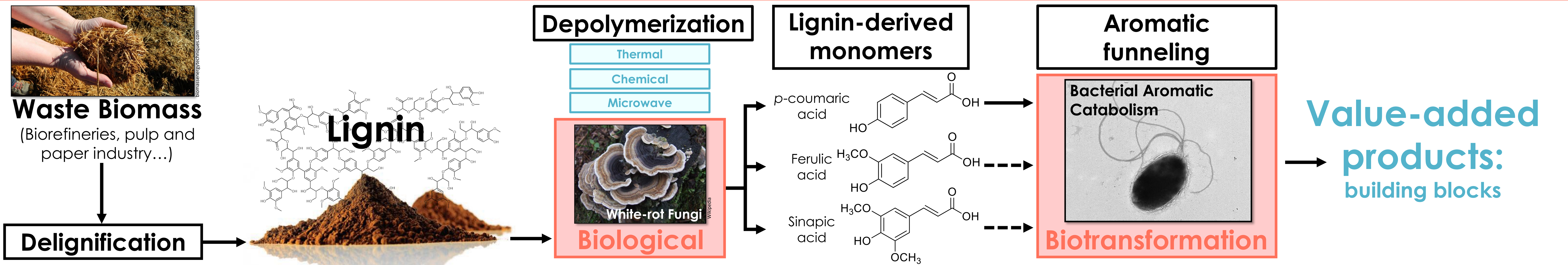
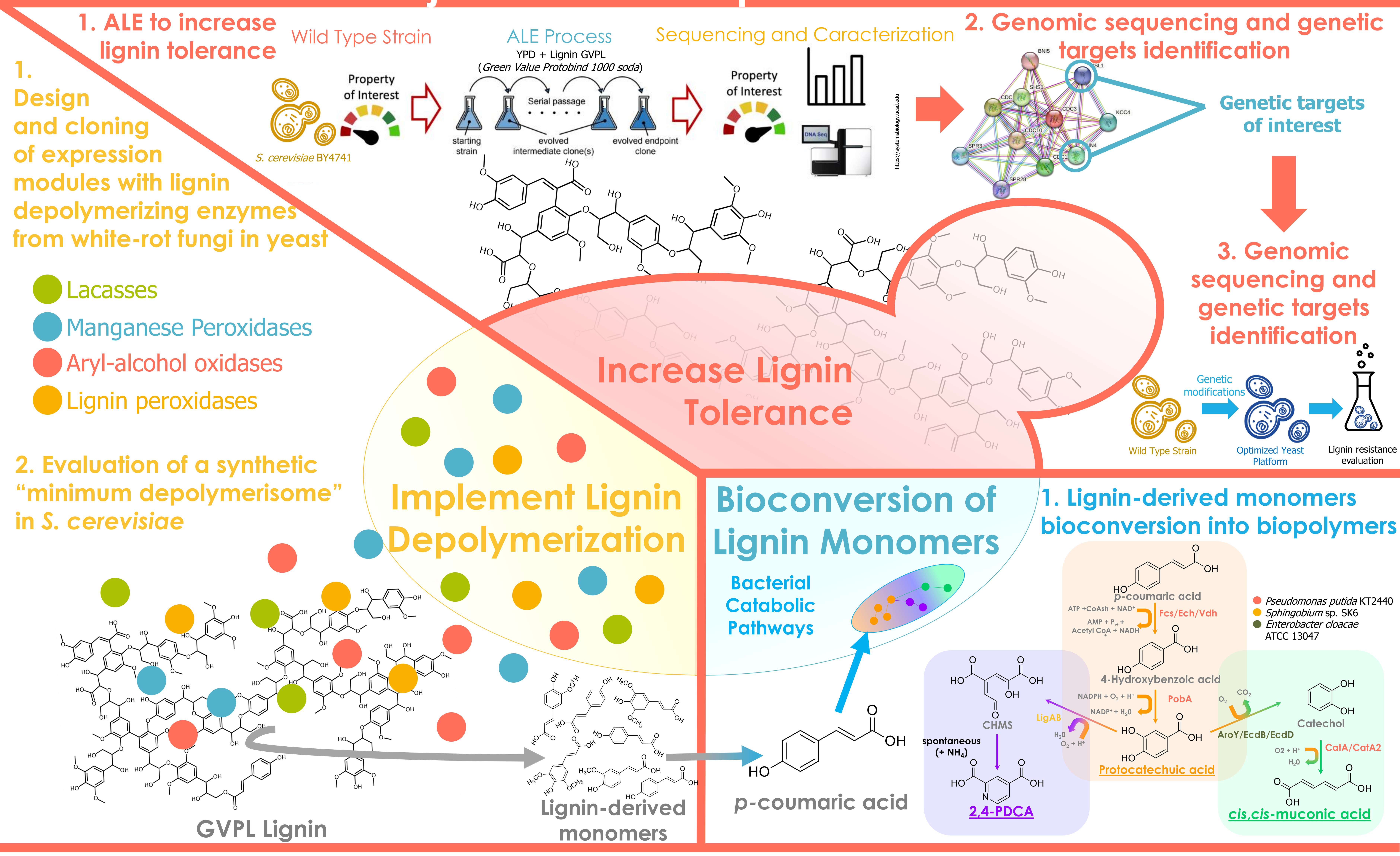
Introduction



There is an urgent need in our societies for **waste management processes that can enable a transition to a circular economy model**. Lignin revalorization to produce value-added molecules is a strategy extensively pursued to solve the underutilization of this high-potential biopolymer. Therefore, it is possible to design processes to produce value-added molecules from lignin, such as sustainable bioplastics. In the **RELAY project** we propose to synthetically combine: **i) a biological lignin depolymerization process** using white-rot fungi enzymes, and **ii) a biotransformation step based in bacterial catabolic pathways** for lignin-derived aromatic monomers. **This one-pot-based approach will use *Saccharomyces cerevisiae* as a biocatalyst**, harnessing the optimal biotechnological properties of this model microbial platform.

Objectives and Expected Results



The main goal of RELAY is to generate a new generation of lignin revalorization biocatalysts based on a *S. cerevisiae* platform to integrate the depolymerization capabilities of WRF and metabolic capabilities of bacteria to bioconvert lignin-derived monomers into value-added products. To this end, lignin tolerance mechanisms in *S. cerevisiae* will be enhanced performing adapted laboratory evolution (ALE) experiments. Furthermore, the efficient expression and secretion of a minimum "lignin depolymerisome", consisting of prototypical enzymes from fungal origin, will be implemented in *S. cerevisiae*. Additionally, *S. cerevisiae* will be also engineered to incorporate heterologous synthetic pathways for the bioconversion of lignin monomers to bacterial catabolic intermediates. The targeted molecules (2,4-pyridine dicarboxylic acid (2,4-PDCA) and *cis,cis*-muconic acid) currently present a high industrial interest as chemical building blocks for the production of new sustainable plastics (PET analogues and bio-nylon). Finally, all this properties will be assembled in a single yeast-based biocatalyst and its performance in scale-up processes will be evaluated.

Future Impact and Conclusions

The results generated by the RELAY Project will contribute to expand the knowledge of lignin revalorization processes. New strategies tested during this work will help to explore more efficiently the techno-economical aspects of this waste management process, improving its economic viability. Additionally, we are presenting new approaches for the production of sustainable bioplastics that belong to a new generation of sustainable bio-based materials. The implementation of this novel recycling technology, that integrates several steps of the revalorization process, will help society to achieve a green growth in a circular economy, improving our life quality.

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