Valorisation of phenolic compounds from lignocellulosic wastes using a new engineered *E. coli* strain

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Abstract:

Valorisation of lignocellulosic biomass waste is considered an important step towards a more sustainable future. Globally, over 1 billion tons of lignocellulosic material are produced every year, and most of them are routinely burnt. Nonetheless, its chemical composition is known to be rich in phenolic compounds such as ferulic acid and vanillin, making it a promising and widely available resource. In this context, the Meat-from-Wood project (PRIN 2022) aims to develop a biobased process capable of converting vanillin and ferulic acid, obtained by the enzymatic hydrolysis of lignin and wheat bran, into L-alanine, an amino acid widely used in cosmetic, pharmaceutical and food industries. A novel biosynthetic pathway for the bioconversion of ferulic acid and vanillin into L-alanine was designed and integrated into *E. coli* K12 MG1655 cell, using the CRISPR/Cas9 technology. The functionality of the pathway was assessed using both in vitro and whole-cell bioconversion experiments. In-silico Flux Balance Analysis was applied to identify the most suitable growth conditions and target genes to be up- or down-regulated to maximize L-alanine production and secretion. The obtained strain's growth was then tested in a bioreactor to further optimize production and yield. A functional cell factory capable of producing added-value products from underutilized compounds found in lignocellulosic wastes would be a valuable asset for improving existing processes and paving the way to sustainability.