A biocatalyst has been designed to work at alkaline pH and high temperature to degrade lignin in the wood conversion sector

CSIC has developed a set of tailor-made alkaliphilic and thermotolerant enzymes (laccases) for use in wood conversion industrial processes, such as the production of pulp and fibreboards, biomass biorefineries and green chemistry.

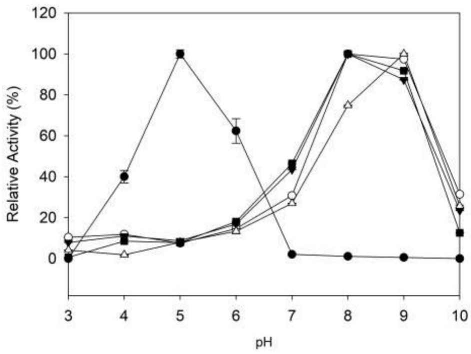
Industrial partners are being sought to collaborate through a patent licence agreement.

An offer for Patent Licensing

By conferring extremophilic properties to laccases, these biocatalysts can be integrated in industrial processes to transform or remove lignin and related compounds more ecologically

This result is part of the WoodZymes project that has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 792070

The enzymes "Laccases" are multicopper oxidases widely distributed in nature. Those produced by wood-decay fungi are of particular biotechnological interest, since they have the ability to oxidise a wider range of aromatic compounds, participating in cross-linking of monomers and degradation of polymers. Fungal laccases act on lignin and lignin-related phenols, as well as on highly recalcitrant environmental pollutants, making the enzymes particularly useful for different biotechnological applications in lignocellulose biorefineries, bioremediation and green chemistry; for example in pulp and paper industries, textile industries, wastewater treatment, xenobiotic degradation and pharma. Importantly, whilst most fungal laccases are only active at acidic pH and temperatures from 30 to 55° C, the new enzymes have been engineered to display laccase activity at neutral and/or alkaline pH (up to pH 10) on kraft lignin and derived phenols, and tolerate temperatures up to 80° C.



Comparison of the maximum activity of a fungal laccase (pH 5, on the left) and the new laccases engineered (pH 8-9, on the right), for oxidation of a lignin-derived phenol.

Main innovations and advantages

- The new extremophilic enzymes overcome the limitations of fungal laccases that work mainly in acidic environments and are rarely thermostable, which facilitates their integration as biocatalysts in the industrial processes, making them more ecofriendly, with less chemicals and residues.
- Kraft lignins are scarcely exploited nowadays because there is no established technology for their valorization; well, these new enzymes can set the basis for the technology that the industry has been looking for, enabling the valorization of industrial lignins into aromatic chemicals for new bio-based products.
- They are applicable in: the pulp & paper industry for transformation of kraft lignins isolated from industrial black liquors, and delignification and bleaching of kraft pulps; wood board manufacture to aid wood fiber bonding, or to produce lignin-based adhesives or resole resins; the textile industry for *in situ* synthesis and fixation of organic dyes in fabrics; eco-friendly hair dyeing; wastewater treatment for pollutant detoxification; green chemistry, e.g. drug synthesis.

Patent Status

European patent application filed

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