Robust biodegradation of naproxen and diclofenac by laccase immobilized using electrospun nanofibers with enhanced stability and reusability - DTU Orbit (19/08/2019)

Robust biodegradation of naproxen and diclofenac by laccase immobilized using electrospun nanofibers with enhanced stability and reusability

Enzymatic biodegradation of pharmaceuticals, using enzymes such as laccase, is a green solution for the removal of toxic pollutants that has attracted growing interest over recent years. Moreover, the application of immobilized biocatalysts is relevant for industrial applications, due to the improved stability and reusability of the immobilized enzymes. Thus, in the present study, laccase was immobilized by adsorption and encapsulation using poly(l-lactic acid)-co-poly(e-caprolactone) (PLCL) electrospun nanofibers as a tailor-made support. The produced biocatalytic systems were applied in the biodegradation of two commonly used anti-inflammatories, naproxen and diclofenac, which are present in wastewaters at environmentally relevant concentrations. The results showed that under optimal process conditions (temperature 25°C, pH 5 and 3 for naproxen and diclofenac respectively), even from a solution at a concentration of 1mgL⁻¹, over 90% of both pharmaceuticals was removed by encapsulated laccase in batch mode. Both immobilized enzymes also exhibited high reusability: after five reaction cycles approximately 60% and 40% of naproxen and diclofenac were removed by encapsulated and adsorbed laccase respectively. In addition, a thorough analysis was made of the products of biodegradation of the two studied pollutants. Furthermore, toxicity study of the mixture after biodegradation of the pharmaceuticals showed that the solutions obtained after the process were approximately 65% less toxic than the initial naproxen and diclofenac solutions.

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