Degradation of estrogens by laccase from Trametes versicolor in enzymatic membrane reactors

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Introduction. This work aims to design and study of an enzymatic membrane reactor (EMR) for the degradation of estrogenic compounds. For this, active membranes were prepared by covalent grafting of laccase Trametesversicolor on the surface of a ceramic membrane Having highlighted the potential of the reactor for the degradation of estradiol (E2) chosen as model substrate, the impact of operating parameters (feed rate, concentration of substrates) on the performance of EMR was studied. To solve problems of instability, different stages of the manufacturing protocol of active membranes were reviewed. Then the operating parameters (pH and temperature) were studied to optimize the conditions for implementation of EMR. It was established that the purification efficiency were maximal at acidic pH (pH 4) but remained stable over a wide temperature range (15 to 40 ° C). The removal rates up to 85% for E2.

Methods. Was used between 6.5 to 10 g/L of Enzyme laccase obtained from Trametes versicolor, immobilizing the enzyme on a ceramic membrane of 0.2 µm pore, the estradiol is substrate used as concentrations between 50-1 ppm, feeding flow of 0.5 and 0.25 L/h and a transmembrane pressure of 1.5 bar, temperatures of 40 and 25 ° C. Developed protocol was used for the immobilization of proteases [3]. The working pH was 4-7. The membrane is prepared with a solution of gelatin and glutaraldehyde to immobilize the enzyme in its interior.
The process conditions are shown in Table 1.

Test	E2 (ppm)	Substrate solution	Time (min)	Q (L/h)
1	50	Tampon pH 4	150	0,5
2	10	RO Water	150	0,5
3	10	DMSO/RO Water	360	0,5
4	10	DMSO/RO Water	360	0,25
5	1	RO Water	150	0,5
6	1	DMSO/RO Water	360	0,5

Table 1. Test made in the REM

Results

Early important activity, around 86% (50 ppm) (figure 1), after stable activity but less important, about 28%. Proven feasibility of REM (degradation estradiol). Phenomenon of partial inactivation of enzymes (modification of the active layer) is observed.

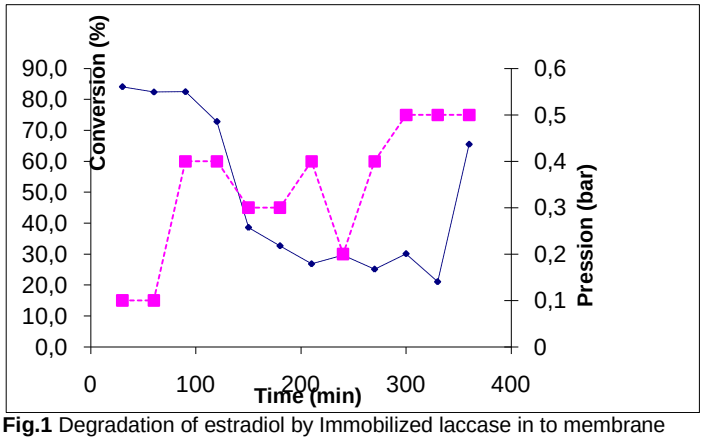

Fig.1 Degradation of estradiol by Immobilized laccase in to membrane

Estrogenic concentration was lower (85% of conversion). In addition, laccase required oxygen as an oxidant, which is comparatively much less expensive than the other products. The kinetic study showed that laccase present the same kind of affinity for the studied estrogen [2]. From a point of view of cost effectiveness, laccase may present important advantages for applications in municipal wastewater treatment because it can to work at the pH and temperature of this effluent. Proven feasibility of REM for the degradation estradiol, substrate concentration induces inhibition of the enzymatic activity because modification of the active layer.

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References.

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