Comparative Study of the Reaction Mechanisms for Paracetamol Degradation by Advanced Oxidation Processes (AOPs)

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Pharmaceuticals are an environmental problem due to their persistence. The use of these products in hospitals, veterinarian clinics and homes, increase their discharges and also those of their transformation products into the environment and their toxicity affects life in ecosystems. The Paracetamol is one of the drugs most widely consumed worldwide and are considered the most self-medication so as model reaction takes. The degradation of Paracetamol in aqueous solutions in the presence of hydrogen peroxide was carried out with of applying main AOP techniques. Three different processes to degrade Paracetamol were studied; namely photocatalysis with homogeneous catalysts with TiO₂ and CuO/TiO₂/Al₂O₃ as well with heterogeneous catalysts by electrocatalysis and photoelectrocatalysis, using modified 100 pores per inch reticulated vitreous carbon electrodes. The electrodes were coated with catalysts such as TiO₂ and CuO/TiO₂/Al₂O₃ by electrophoresis followed by heat treatment [1]. The reaction intermediate degradation products were detected and they were slightly different according to the electrode that was used and were analyzed using an HPLC. Solvent Deliver System PM80, fitted with UV–Vis detector 116A and temperature control LC-22°C. The mobile phase was a 30/70 % (v/v) mixture of methanol/phosphate buffer adjusted to pH 2.6 at 0.8 mL/min flow rate. The concentration of the phosphate buffer was 1 x 10⁻³ M and the column was an Alltima HPC18 of 5µ with 4.6 mm ID and 150 mm length. The retention times of the carboxylic acids intermediates such as oxalic (2.18 min) and oxamic acid (2.3 min) as well as those of hydroquinone (2.6 min), benzoquinone (3.7 min) and Paracetamol (3.2 min) were compared with standards purchased from Merck. The intermediates were chosen based on the literature reports of the degradation of Paracetamol. Typically, 20 µL of a solution containing one standard at the time was injected into the chromatographic column. The concentration of the standards varied between 12.00 and 15.00 mg L⁻¹. Before injecting the samples from the oxidation process into the HPLC, the samples were analysed by an UV–Vis spectrophotometer Cary 50 Probe to confirm the presence or the absence of organic compounds. The total organic carbon (TOC) was determined at 680°C with a TOC analyser SHIMADZU. An acid digestion method was used to prepare the samples before the TOC analysis.