Studies on the fate of pharmaceuticals in aqueous media: synthesis, characterization and detection of abiotic transformation products using advanced oxidation processes

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Pharmaceuticals as well as personal care products are classified as emerging pollutants of increasing concern due to possible negative impacts on human health and the environment (Casellas 2006). They are constantly introduced in sewage treatment plants either through excretion or disposal by flushing of unused or expired medication, or directly within the sewage effluents of wastewater treatment plants or hospitals. Pharmaceuticals have complex chemical structures, showing a wide range of persistence and being capable of reacting in an aqueous medium under the action of chemical, biological or physical agents. They end up in surface and ground water and can even be found in drinking water, representing adverse effects on terrestrial and aquatic organisms (Fenett 2006). Thus, the transformation products from degradation of parent drug replace gradually the initial molecule in the environment which could cause a significant effect by the appearance of new pollutants that may be even more toxic that the parent one. On yhe other hand, these transformation products constitute markers of past or current presence of the drug in the environment (Leclerq et al., 2009; Celiz et al., 2009).

Faced with this problem, we believe it is necessary to synthesize the transformation products (TPs) to both enable the development of their detection methods and the determination of their potential toxicity. My thesis project aims to develop a multidisciplinary methodology to be drawn from the study of four selected pharmaceuticals (ranididine, furosemide, propranolol, atenolol) on risk criteria and representative chemical structures, frequently encountered in water resources.

We propose firstly, to prepare the largest number or TPs of a particular drug using three complementary approaches: bioconversion, electrochemical and chemical oxidation, and advanced oxidation processes. In a second step, analysis of all the obtained compounds is intended to provide most likely environmental transformation products which will be synthesized in order to develop analytical methods for their detection in environmental matrices and to study their potential toxicity. Expected results are the development of a predictive methodology applicable to the study of any environmentally questioned molecule. The benefits will be related to the pharmaceutical, cosmetic, agrochemical, chemical industries, as well as organizations and industries specializing in the management of water resources.

References

Casellas, C. (2009). Les medicaments: Contaminants émergents? *Environement, Risques et Santé.* **5**, 225.

Fenet, H.; Gomez, E.; Leclerc, M.; Casellas, C. (2006). Devenir des medicaments dans l'environement. *Environement, Risques et Santé*, **5**, 243-247.

Leclercq, M. O. ; Mathieu, O. ; Gomez, E. ; Casellas, C. ; Fenet, H. ; Hillaire-Buys, D. (2009). Presence and fate of carbamazepine, oxacarbazepine and seven of their metabolites at wastewater treatment plants. *Archives of environmental contamination and toxicology.* **56**, 408-415.

Celiz, M.D.; Tso, J. ; Aga, D.S. (2009). Pharmaceutical metabolites in the environment; analytical challenges and ecological risks. *Environmental Toxicology and Chemistry*. **28**, 2473-2484.