

Enantiomeric fraction evaluation of pharmaceuticals in an aerobic granular sludge sequencing batch reactor

Catarina L. Amorim ^a, Irina S. Moreira ^a, Ana Rita Ribeiro ^{a,b,c}, Lúcia H.M.L.M. Santos ^{d,e}, Cristina Delerue-Matos ^d, Maria Elizabeth Tiritan ^{b,e,f} and Paula M.L. Castro ^a

^a CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal

^b CESPU, Instituto de Investigação e Formação Avançada em Ciências e Tecnologias da Saúde, R. Central de Gandra, 1317, 4585-116 Gandra PRD, Paredes, Portugal

^c Present affiliation: LCM – Laboratory of Catalysis and Materials – Associate Laboratory LSRE-LCM, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal

^d REQUIMTE, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Rua Dr. António Bernardino de Almeida, 431, 4200-072 Porto, Portugal

^e CIIMAR– Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Rua dos Bragas, 289, 4050-123 Porto, Portugal

^f Laboratório de Química Orgânica e Farmacêutica, Departamento de Ciências Químicas, Faculdade de Farmácia da Universidade do Porto, Rua Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal

Pharmaceutical compounds are emerging environmental contaminants that have received growing attention over the last two decades. Several of these pharmaceuticals currently in use are chiral. Therefore, the evaluation of the enantiomeric fraction (EF) of chiral pharmaceuticals (CPs), during the removal processes occurring in the environment, is crucial for assessing the fate of such micropollutants. Aerobic granular sludge (AGS) technology is one of the promising biotechnologies in wastewater treatment. However, due to its technological novelty, up to now there is a lack of information regarding the fate of pharmaceuticals on such technology.

In this study, the enantioselective removal of a mixture of eight CPs was monitored in a laboratory-scale AGS bioreactor. A synthetic wastewater supplied with racemic mixture (1.3 µg/L of each enantiomer) of alprenolol, bisoprolol, metoprolol, propranolol, fluoxetine, its metabolite norfluoxetine, venlafaxine and salbutamol was used to continuously feed the bioreactor during 28 days. Quantification of the CPs in influent and effluent samples was carried after pre-concentration and cleanup by solid phase extraction and analysis by liquid chromatography tandem mass spectrometry using an Astec ChirobioticTMV, 5 µm (150 × 2.1 mm i.d.).

Enantioselective monitoring of the fate of CPs during exposure revealed that the pharmaceutical norfluoxetine at effluent exhibited EF values ranging from 0.44 to 0.74, indicating stereoselective processes occurring during the treatment, with preferential removal of the (*R*)-enantiomer. On the other hand, non-enantioselective removal was observed for all other CPs. Furthermore, high removal efficiencies (>96%) for both (*R*)- and (*S*)-enantiomers were achieved for norfluoxetine. For fluoxetine, relatively minor removal efficiency was observed, with approximately 85% of each enantiomer being removed from the total influent load. Total concentrations of all other CPs were reduced by about 47–61%.

This study suggests that EF evaluation of CPs could be an effective mean of gaining insights into the overall treatment performance.

Keywords: Aerobic granular sludge; enantiomeric fraction; chiral pharmaceuticals; stereoselectivity

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