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Short Communication

# Potential of *Phragmites australis* for the removal of veterinary pharmaceuticals from aquatic media

### Pedro N. Carvalho<sup>a,\*</sup>, M. Clara P. Basto<sup>a</sup>, C. Marisa R. Almeida<sup>b</sup>

<sup>a</sup> CIMAR/CIIMAR, Faculdade de Ciências, Universidade do Porto, R. Campo Alegre s/n, 4169-007 Porto, Portugal <sup>b</sup> CIMAR/CIIMAR, – Centro Interdisciplinar de Investigação Marinha e Ambiental, Universidade do Porto, R. dos Bragas 289, 4050-123 Porto, Portugal

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#### ABSTRACT

The potential of *Phragmites australis* was evaluated for the removal of three veterinary drugs, enrofloxacin (ENR), ceftiofur (CEF) and tetracycline (TET), from aquatic mediums.

Results showed that the plant promoted the removal of 94% and 75% of ENR and TET, respectively, from wastewater. Microbial abundance estimation revealed that microorganisms were not a major participant. Occurrence of drugs adsorption to plant roots was observed in small extension. Therefore, main mechanisms occurring were drug removal by plant uptake and/or degradation. Present results demonstrated the potential of *P. australis*-planted beds to be used for removal of pharmaceuticals from livestock and slaughterhouse industries wastewater.

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#### 1. Introduction

The fate of pharmaceutical compounds in the aquatic environment became an emerging area of research, not only from the human application, but also from veterinary application integral to the growing animal food industry. The widespread use of some drugs and their generally inefficient removal from wastewaters in wastewater treatment plants (WWTPs) are the main reasons for the frequent detection of pharmaceuticals in aquatic bodies. Therefore, there is a growing need for alternative wastewater treatment processes for removing pharmaceuticals from waters.

Constructed wetlands (CWs) can be managed as water quality improving systems as alternative or additive low-cost wastewater treatments (Dordio et al., 2010). Although these systems are widely used for municipal wastewater, the application to agricultural or industrial wastewater has to be carefully analyzed once wastewater composition variability and treatment needs can be very specific (Calheiros et al., 2007). The removal of conventional wastewater parameters (biochemical and chemical oxygen demand, total suspended solids and nutrients) in CWs has been object of extensive research. However, much less research studies have assessed their efficiency in the removal of a wide range of pollutants, with only a few works focusing on the removal of human pharmaceuticals (Dordio et al., 2009; Hijosa-Valsero et al., 2011). Regarding veterinary drugs, to our knowledge there is only one paper focused on the removal of sulfonamides from swine wastewater by a constructed macrophyte floating bed system (Xian et al., 2010).

The choice of plants is an important issue in CWs, once they have to survive the potential toxic effects of the wastewaters and also its variability. The most widely used plants are the common reed (*Phragmites australis*), the cattails (*Typha* spp.), the bulrushes (*Scirpus* spp.) and the reed canarygrass (*Phalaris arundinacea*) (Calheiros et al., 2007).

The aim of the present work was to evaluate the capacity of *P. australis* to remove three veterinary pharmaceutical compounds, namely enrofloxacin (ENR), ceftiofur (CEF) and tetracycline (TET) from aquatic mediums, including livestock and slaughterhouse wastewaters. These compounds belong to three different families (fluoroquinolone, cephalosporin and tetracyclines, respectively) and are among those more extensively used for therapeutic and prophylactic in Portuguese livestock industry.

#### 2. Methods

#### 2.1. Sampling of plants

*P. australis* with shoots were collected in *Rio Lima* estuary (North of Portugal) in July 2010 (ENR trial), November 2010 (CEF trial), February 2011 (TET trial) and May 2011 (Wastewater trial). Roots, after being thoroughly washed to remove any sediment particles attached to their surface, were submersed (*ca.* 1 min) in antimicrobial agent Micropur<sup>®</sup> solution, to stop microbial action and then



<sup>\*</sup> Corresponding author. Tel.: +351 220402570; fax: +351 220402659. *E-mail address:* pedro.carvalho@fc.up.pt (P.N. Carvalho).

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