Predicted environmental concentrations of carbamazepine, oxcarbazepine and their main metabolites in a coastal system

H. Fenet[a], L. Arpin-Pont[a], A. Van Houtte[b], D. Munaron[b], A. Fiandrino[b], D. Hilaire-Buys[c], O. Mathieu[c]; H. Budzinski[d], S. Chiron[a], C Boillot[a], E. Gomez[a],

a: UMR 5569 Hydrosciences Montpellier, Université Montpellier 1, Montpellier, France;
b: IFREMER, Laboratoire Environnement et Ressources du Languedoc-Roussillon (LER-LR), Sète, France;
c: Laboratoire de Pharmacologie Médicale et Toxicologie, Hôpital Lapeyronie, Montpellier, France
d: EPOC - UMR 5805 CNRS, Talence, France

Introduction

Pharmaceuticals are widely released in aquatic environment through treated wastewaters. They reach coastal zone indirectly via streams or directly though marine outfalls however data concerning this contamination in coastal waters are scarce.

Environmental Risk Assessment (ERA) of pharmaceuticals have been conducted mostly in surface waters and has not been performed in coastal zone. The first step of ERA is to evaluate the exposure through predictive environmental concentration (PEC) values.

The aim of this study was to predict the occurrence of some pharmaceuticals in a coastal aera subjected to treated wastewater (TWW) reject through a marine outfall (Fig 2.). Among pharmaceuticals, Carbamazepine, Oxcarbazepine and their main metabolites (Fig 1.) were chosen. CBZ has been proposed as an indicator of wastewater contamination and has been already detected in Mediterranean (Munaron et al., 2011).

Prediction was performed based on local pharmaceuticals consumption recording and a review of pharmacokinetics data. PECs values were estimated in TWW and at the marine outfall and compared with MECs obtained by direct quantification and with POCIS implementation.

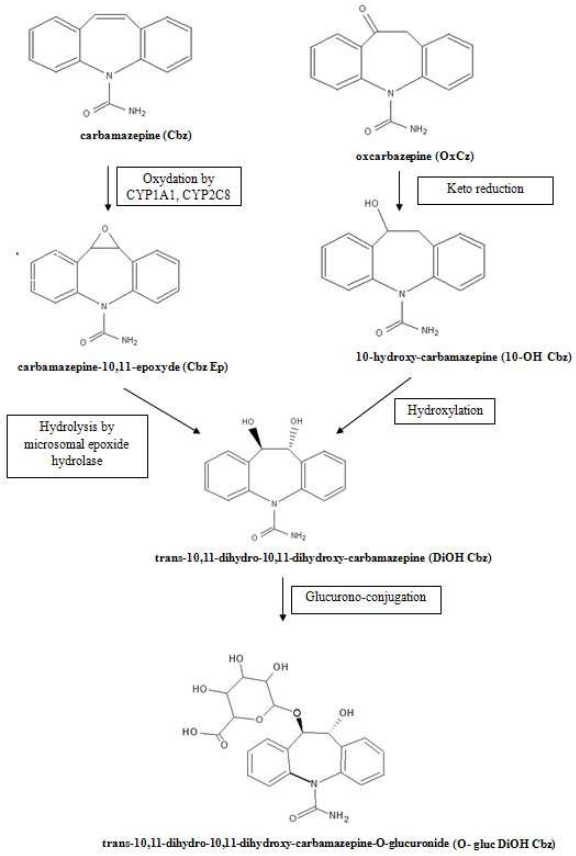

Fig.1: Main metabolic pathways of carbamazepine and oxcarbazepine

Materials and methods

PEC

Medical care consumption data (g of CBZ and OxCBZ sales per month)
Pharmacokinetics data (% of excreted forms : parents compounds and metabolites)
% elimination in STEP, flux effluent

PEC effluent : Sales (g) * % excreted/ % elimination*flux
PEC coastal zone : PEC/100 (TGD, 2003)

MEC

MEC effluents :

24h homogenate effluents sampling (n=8)
Filtration, SPE OASIS HLB, analysis LC-MS (Leclercq et al., 2009)

MEC coastal zone : POCIS

Implementation for one month near the submarine outfall (n=6)
Analysis as described by Munaron et al. (2011).

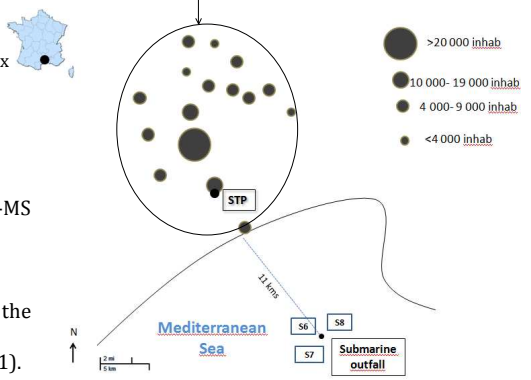

Fig.2: Study area and sampling points (S6-S8)

Results - Discussion

Sales (g)	January 2011	February 2011	March 2011	April 2011	May 2011	June	Mean
Cbz	10427	9564	10914	9859	10547	10021	10222
OxCz	2527,5	2280	2970	2662,5	3217,5	2572,5	2705

Table 1: Consumption data of Cbz and OxCz from January to June 2011

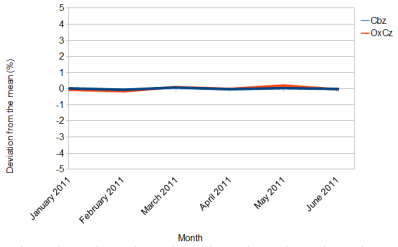

Fig.3: Deviation from the mean of Cbz and OxCz from January to June 2011

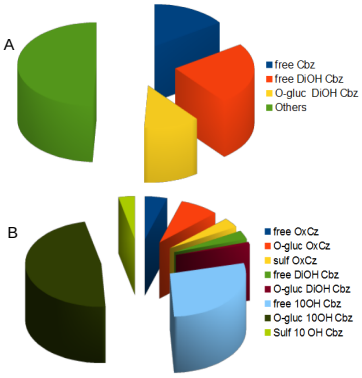

Fig. 4 : Metabolits excretion pourcentages of absorbed dose of Cbz(A) and OxCz (B)

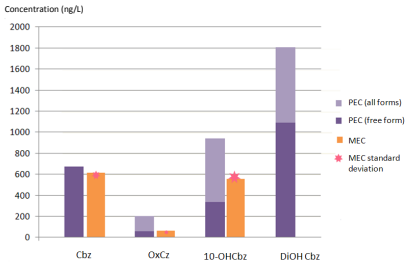

Fig.5: PECs and MECs in treated wastewater effluents

All forms (free and conjugated form) considering a total deconjugaison of O-glucuronides during wastewater treatment

Cbz and Oxcz sale are stable from January to June (Fig. 3)

Cbz and Oxcz are excreted as parent compounds or metabolites, free or conjugated as glucuronides (Fig.4)

In wastewater effluent, MECs estimation is in good agreement with MECs (Fig5).

Molecule	Cbz	OxCz	10-OHCbz	DiOHCbz
PEC(all –free forms)	6.7-6.7	0.5-2	3.3-9.4	10.5-17.7

Table 2: PEC in coastal zone (ng/L)

Molecule	Cbz	OxCz	10-OHCbz	DiOHCbz
POCIS Sorbent	0.4- 1.8	nd	0.2-2.2	nd

Table 3: concentrations in POCIS in ng/g of sorbent
nd not detected

Conclusion

Further studies have to be performed for PEC estimation in coastal area including a hydrodynamic numeric model, which take into account diffusion, advection in seawater.

References

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TGD, Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment of new notified chemicals and Commission Regulation (EC) No.1488/94 on risk assessment of existing chemicals (1996). Luxembourg: Office for Official Publications of the European Communities; 2003.

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