

Pharmaceutical Residues in the Northern Norwegian Environment



R. Kallenborn¹, S. Weigel², E. Jensen³, H. Hühnerfuss²,

1 Norwegian Institute for Air Research (NILU), Tromsø, Norway
 2 Institute of Organic Chemistry, University of Hamburg, Germany;
 3 Institute for Pharmacy, University of Tromsø, Norway



Background

The presence of selected pharmaceuticals in different environmental compartments was reported for the first time by Richardson and Bowron (1985). Since then, many international scientific studies reported about pharmaceuticals in the environment. The here presented study was designed to elucidate levels and discharges of selected pharmaceuticals in the environment in the marine environment around Tromsø, a middle size city in Northern Norway.

Results

Table 1: Compounds selected for analysis

Compound	Application
Ibuprofen	Pain killer
Hydroxy-Ibuprofen	Transformation product (Ibuprofen)
Carboksyl-Ibuprofen	Transformation product (Ibuprofen)
Diclofenac	Analgetics
Propyphenazone	Analgetics
Klofibrinsyre	Lipid regulating agent (transformation product)
Carbamazepine	Antiepileptikum
Sertraline	Antidepressant
Paroxetine	Antidepressant
Metoprolol	β-blocker
Propranolol	β-blocker
Caffein	Additive to pharmaceutical products and food products

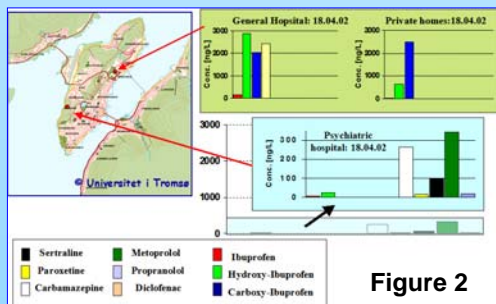


Figure 2

Sewage

Ibuprofen was detected in all samples in concentrations ranging from ~ 10 to 400 ng/L (figure 2) while its main metabolites hydroxy-ibuprofen (Ibu-OH) and carboxy-ibuprofen (Ibu-CX) were present at significantly higher concentrations (up to ~ 3 µg/L).

Diclofenac was only detected in samples related to the psychiatric hospital (3 ng/L) and the University general hospital (Figure 1: 2,4 µg/L).

The antiepileptic carbamazepine and the antidepressants paroxetine and sertraline were found in sewage affected by the psychiatric hospital.

Caffeine was determined at high concentrations (20 - 280 µg/L) in all Samples (figure 3). It correlates well with the levels of other compounds of concern (e.g., Ibu-OH).

Figure 1: Sampling site Tromsø (Norway)

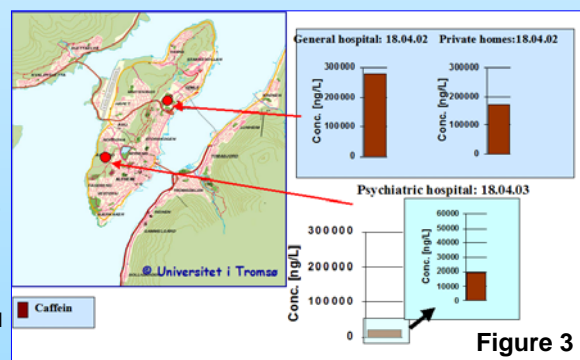
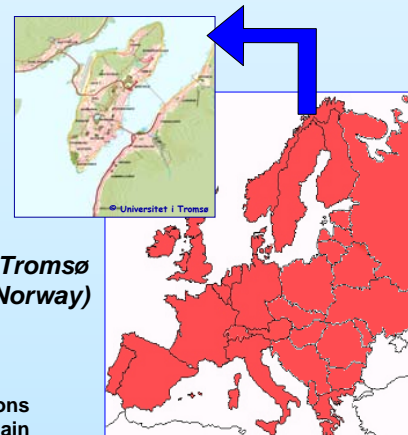


Figure 3

Seawater

Only caffeine, ibuprofen and its metabolites were detectable in significant amounts in Tromsø sound seawater (figure 4 and 5).

Caffeine-concentrations were found in the same order of magnitude throughout all sea water samples, ranging from 20 to 80 ng/L.

Ibuprofen and its major metabolites were present in most seawater samples at concentrations up to 2 ng/L. Concentration levels [seemed] appeared slightly elevated in Samples close to the effluent of the General hospital, where the contributing sewer contained high levels of these contaminants (figure 2). Carboxy-ibuprofen was the dominant compound in most samples. This result is in contrast to other findings from other, where the ratio Ibu-CX/Ibu-OH strongly decreases after sewage treatment and subsequent release into the aquatic environment.

Conclusions and perspectives

Human activities result usually in locally restricted elevated concentrations of hydrophilic contaminants. Also in our study, elevated levels for caffeine, ibuprofen and its metabolites were found. Due to specific discharge pattern, the presence of hospital related release of other pharmaceuticals (e.g., β-blockers, antidepressants etc) were confirmed in municipal sewage.

Due to the special northern weather conditions in the Norwegian Arctic, degradation processes are expected to be hindered by climate factors [e.g., temperature, light conditions]. As a consequence, higher compound stability and residence time for contaminants compared to lower latitudes regions can be expected.

Acknowledgements

This study was funded by the Research Council of Norway (NFR) project no.: 141465/720 and the German Academic Exchange Service (DAAD).

Reference:

Richardson M.L. & J.M. Bowron (1985): The fate of pharmaceutical chemicals in the aquatic environment. J. Pharm. Pharmacol. 37: 1-12.

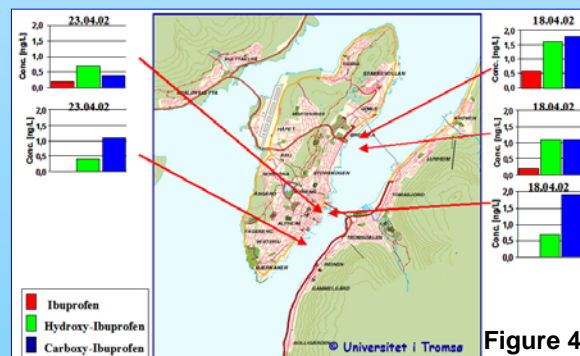


Figure 4

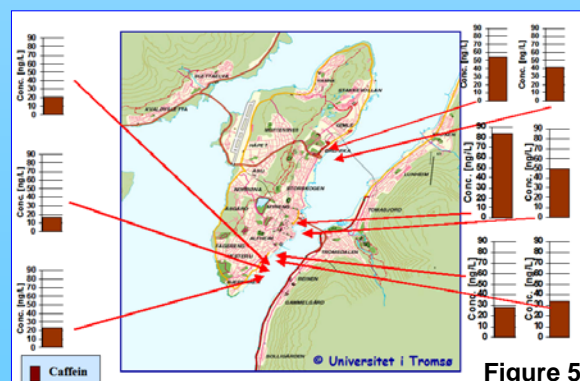


Figure 5