Pharmaceuticals and additives in personal care products as environmental pollutants: Faroe Islands, Iceland and Greenland

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INTRODUCTION

In recent years the focus in analyses of environmental pollution has widened to include not only the legacy POPs, but also compounds which are more water soluble and less persistent. Such compounds are found among pharmaceuticals and additives in personal care products (PPCPs). The main aim of the study was to get an idea of the volume of PPCPs which are discharged via sewage lines to the marine environment in Faroe Islands, Iceland and Greenland. A survey of the most commonly used pharmaceuticals in the countries involved formed the basis for the selection of pharmaceuticals to be analysed. Following consultations with analytical experts resulted in the final analytical scheme.

SAMPLING CAMPAIGNS

Year: 2010 with supplementary sampling in 2011

Locations: Capitals of Greenland (Nuuk), Iceland (Reykjavik) and the Faroe Islands (Torshavn) and in one or more other towns around Reykjavik and Torshavn

SAMPLES

Number: 23 samples, including effluents from waste water treatment plants and surface water from recipients

Origin: discharge from household, lighter industry and hospitals. Among the waste water lines sampled, some discharge waste water went directly to the recipient without treatment.

EXTRACTION AND ANALYSIS

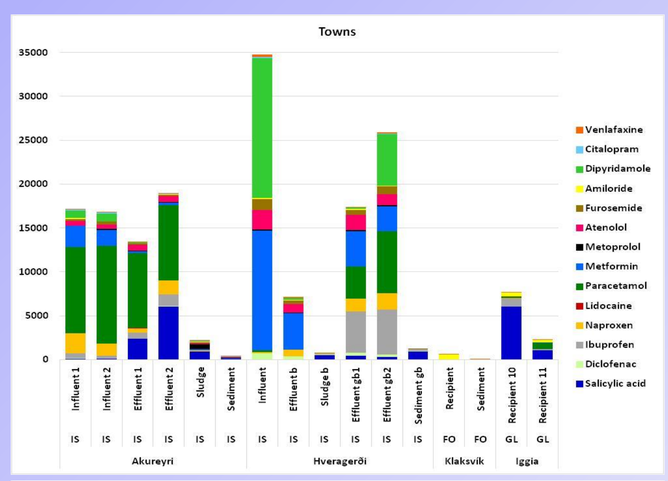
The pharmaceuticals and/or metabolites of such were extracted by either liquid phase microextraction (LPME) or solid phase extraction (SPE) and analysed by ultra-high-pressure liquid chromatography triple-quadrupole mass-spectrometry (UHPLC-MS/MS).
The additives in personal care products were up-concentrated by SPE and analysed by GC-MS/MS or LC-MS/MS.

SELECTED RESULTS

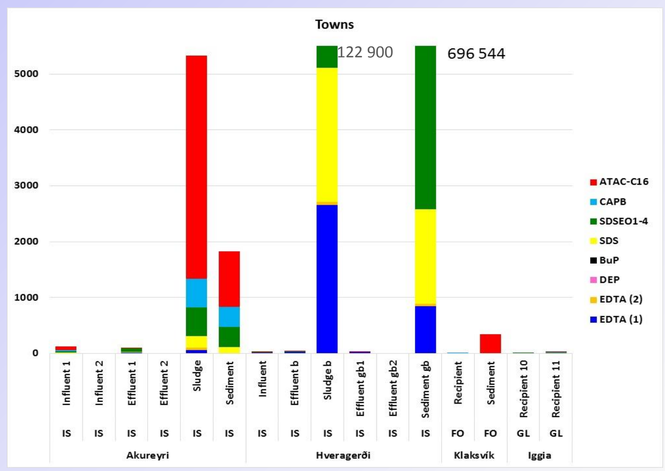
Pharmaceuticals *in different matrixes of towns (A), hospitals (B) and capitals (C). Concentrations in* ***ng/L*** *for* ***water*** *samples and* ***µg/kg*** *for* ***sludge*** *and* ***sediment*** *samples*

Additives in personal care products *in different matrixes of towns (D), hospitals (E) and capitals (F). Concentrations in* ***ng/L*** *for* ***water*** *samples and* ***µg/kg*** *for* ***sludge*** *and* ***sediment*** *samples*

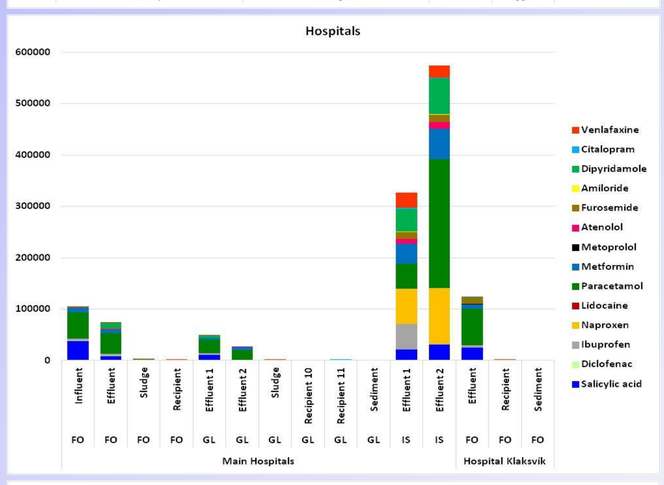
A)



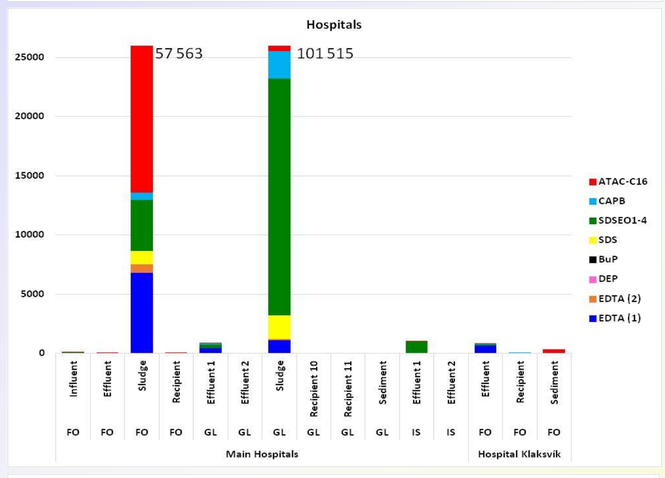
D)



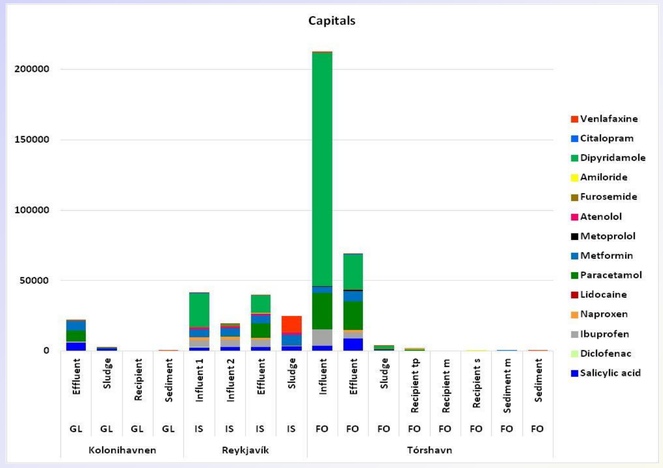
B)



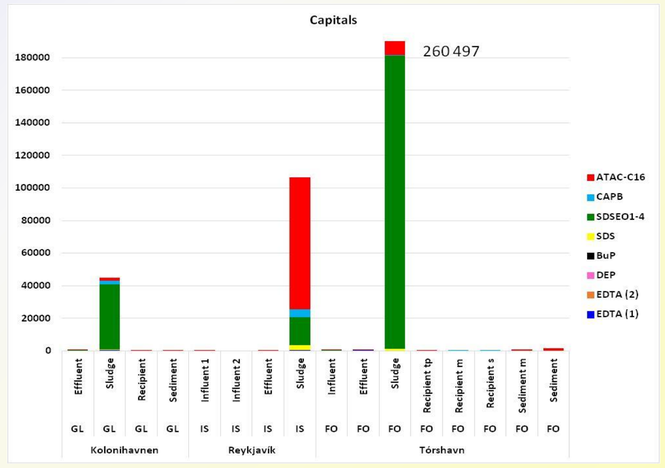
E)



C)



F)



DISCUSSION

❖ Some of the analysed PPCPs occurred in every or almost every sample; among these were diclofenac, ibuprofen, lidocaine, naproxen, metformin, citalopram, venlafaxine, amiloride, furosemide, metoprolol, sodium dodecyl sulphate and cetrimonium salt (ATAC –C16).

❖In general, concentrations of pharmaceuticals were higher in influent than in effluent waters, and all but paracetamol, occurred in higher concentrations in sludge and sediments than in liquids.

❖The PPCPs occurring in highest mean concentrations in effluent waters were diethyl phthalate > ethylene diamine tetraacetic acid > SDSEO1-4 > butylparaben ≈ cocoamidopropyl betaine ≈ paracetamol > salicylic acid ≈ dipyridamole ≈ metformin, where the upper bound mean concentration of DEP and metformin was 740 µg/l (n= 8) and 5 µg/l (n=10) respectively.

❖Samples from Hospitals showed generally higher concentrations of pharmaceuticals then samples from other sites in all type of sample materials, with local variations due to differences in capacity of the hospitals.

❖Regarding PCPs the surfactants SDSEO1-4, ATAC-C16, CAPB and the complexing agent EDTA were detected in highest concentrations in WWTP effluent waters, sludge and sediments. The sediment and sludge probably act as a sink for those substances.

❖Limitations of the study are the relatively low number of samples per site and that not always complete sample sets were available.

CONCLUSIONS

The present study has provided a first indication of the concentration levels of PPCPs being discharged to the recipients in selected localities in Faroe Islands, Iceland and in Nuuk, Greenland.
It has identified a high number of PPCPs in waste water, waste water treatment plants and recipients there.
Further investigations are recommended in order to fill knowledge gaps as daily/seasonal variations, removal capacity of the WWTPs etc.

ACKNOWLEDGEMENT

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REFERENCE

Huber, S., Remberger, M., Goetsch, A., Davanger, K., Kaj, L., Herzke, D., Schlabach, M., Jørunsdottir, H.O., Vester, J., Arnorsson, M., Mortensen, I., Schwartsson, R., Dam, M.: *"Pharmaceuticals and personal care products as environmental pollutants in Faroe Island, Iceland and Greenland*". Nordic Council of Ministers 2013, Thema Nord 2013:541