A first risk assessment of pharmaceuticals and additives in personal care products in effluents and recipient waters from 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.

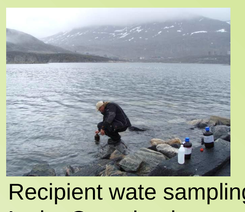
ANALYSIS and RISK ASSESSMENT

Analytes - 38 in pharmaceuticals (incl. metabolites)
- 7 additives in personal care products

Calculation

$$\frac{\text{Measured Environmental Concentration (MEC)}}{\text{Predicted no-effect Concentration (PNEC)}}$$

For effluents: (MEC/10) / PNEC



Recipient wate sampling at Iggia, Greenland

Effluent Klaksvik Hospital, Faroe Islands

Recipient water sampling tool, Greenland

Effluent water sampling, Kolonihavnen, Faroe Islands

RESULTS I

Effluent waters

Calculated risk factors and concentrations of pharmaceuticals (ng/L) and additives of personal care products (µg/L)

			Towns								Hospitals								Capitals						
			Akureyri IS		Akureyri IS		Hveragerði IS		Hveragerði IS		Hveragerði IS		Main Hospital FO		Main Hospital GL		Main Hospital GL		Hospital Klaksvik FO		Kolonihavnen GL		Reykjavik IS		Tórshavn FO		
Compounds	PNEC	MEC/10	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	References
Pharmaceuticals	***ng/L***																										
Salicylic acid	**90000**	239		0.003	603	0.007	< 41.7	-	46.0	5.11E-04	30.2	3.35E-04	870	0.010	1100	0.012			2460	0.027	583	6.48E-03	265	0.003	874	0.010	fass.se
Amiloride	**NA**	4.09	NA		8.50	NA	4.78	NA	12.3	NA	6.44	NA	0.83	NA	< 3.03	NA	< 3.03	NA	< 3.03	NA	< 3.03	NA	216.81	NA	22.82	NA	
Amlodipine	**280**	3.86	0.014		7.29	0.026	< 4.17	-	4.50	0.016	3.22	0.012	9.81	0.035	12.1	0.043			44.8	0.160	1.28	0.005	< 4.17	-	31.9	0.114	fass.se
Atenolol	**NA**	71.1	NA		70.7	NA	97.7	NA	173	NA	125	NA	18.8	NA	31.1	NA	47.0	NA	< 20.8	NA	< 20.8	NA	109	NA	< 20.8	NA	
Bendroflumethiazide	**23000**	< 0.42	-		< 0.42	-	< 0.42	-	< 0.42	-	0.13	5.48E-06	0.14	6.01E-06	< 0.42	-			0.70	3.04E-05	< 0.42	-	< 0.42	-	0.65	2.81E-05	fass.se
Candesartan	**12**	< 2.08	-		< 2.08	-	6.48	0.540	4.80	0.400	5.43	0.452	14.2	1.18	< 2.08	-	< 2.08	-	25.1	2.09	< 2.08	-	< 2.08	-	11.1	0.927	Kümmerer and Hempel,
Citalopram	**8000**	5.90	0.001		2.69	3.36E-04	1.22	1.52E-04	1.77	2.21E-04	2.20	2.76E-04	10.1	0.001	19.2	2.40E-03			54.0	0.007	13.0	0.002	6.92	0.001	11.7	0.001	Besse et al., 2008
Diclofenac	**100000**	3.34	3.34E-05		6.34	6.34E-05	39.0	3.90E-04	34.2	3.42E-04	30.0	3.00E-04	59.7	5.97E-04	1.43	1.43E-05			13.8	1.38E-04	2.35	2.35E-05	21.5	2.15E-04	14.8	1.48E-04	fass.se
Dipyridamole	**NA**	8.08	NA		< 16.05	NA	20.4	NA	11.3	NA	588	NA	1110	NA	464	NA			170	NA	8.39	NA	1250	NA	2460	NA	
Enalapril	**NA**	1.14	NA		1.15	NA	0.16	NA	2.27	NA	2.02	NA	12.0	NA	11.3	NA	32.2	NA	5.74	NA	2.61	NA	1.92	NA	13.5	NA	
Enalaprilat	**NA**	1.01	NA		1.22	NA	1.37	NA	1.88	NA	2.79	NA	7.13	NA	3.90	NA	5.03	NA	3.90	NA	1.61	NA	1.26	NA	7.31	NA	
17β-Estradiol	**0.80**	< 208			< 208	-	< 208	-	< 208	-	< 208	-	< 208		37.5	46.9	34.2	42.7	< 208	-	35.7	45	24.9	31	< 208		fass.se
Estriol	**0.75**	2.28	3.04		< 20.8	-	< 20.8	-	5.78	7.70	5.34	7.12	19.8	26.4	14.0	18.6	13.5	18.0	3.10	4.1	2.54	3.4	5.39	7.2	7.59	10.1	Schlabach et al., 2007
Estrone	**NA**	0.38	NA		< 3.73	NA	< 3.73	NA	1.29	NA	1.02	NA	1.85	NA	1.89	NA	2.10	NA	0.74	NA	0.78	NA	1.33	NA	1.32	NA	
17α-Ethinylestradiol	**0.10**	< 208	-		< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	fass.se
Fluoxetine	**110**	0.53	0.005		< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-			< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	fass.se
Furosemide	**45140**	12.0	2.67E-04		15.2	3.36E-04	46.0	0.001	58.8	0.001	90.9	0.002	114	0.003	4.73	1.05E-04			1140	0.025	8.43	1.87E-04	33.7	0.001	61.2	0.001	fass.se
Glicazide	**NA**	< 2.08	NA		< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	2.96	NA	< 2.08	NA	< 2.08	NA	2.26	NA	< 2.08	NA	< 2.08	NA	2.40	NA	
Hydrochlorothiazide	**100000**	41.3	4.13E-04		41.0	4.10E-04	73.7	0.001	98.4	0.001	94.4	0.001	35.4	3.54E-04	0.64	6.42E-06	0.63	6.26E-06	34.5	3.45E-04	2.26	2.26E-05	61.7	0.001	27.8	2.78E-04	fass.se
Ibuprofen	**7100**	64.0	0.009		132	0.019	< 0.42	-	473	0.067	508	0.072	338	0.048	281	0.040			450	0.063	70.0	0.010	506	0.071	419	0.059	fass.se
Levothyroxine	**497000**	< 1.61	-		< 1.61	-	< 1.61	-	0.16	3.29E-07	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	0.17	3.46E-07	< 1.61	-	fass.se
Lidocaine	**106000**	6.14	5.79E-05		0.53	4.95E-06	0.13	1.24E-06	1.42	1.34E-05	< 0.42	-	0.16	1.55E-06	0.06	6.04E-07			0.30	2.80E-06	< 0.42	-	< 0.42	-	0.43	4.02E-06	Kümmerer and Hempel,
Losartan	**331000**	17.5	5.30E-05		16.3	4.93E-05	32.7	9.87E-05	28.1	8.50E-05	27.6	8.35E-05	15.9	4.81E-05	7.43	2.25E-05	2.15	6.49E-06	29.2	8.82E-05	16.5	4.98E-05	16.2	4.88E-05	2.29	6.93E-06	fass.se
Metformin	**101000**	23.4	2.32E-04		30.5	3.02E-04	41.4	0.004	403	0.004	283	0.003	756	0.007	358	0.004	590	0.006	795	0.008	680	0.007	559	0.006	742	0.007	Kümmerer, 2004
Metoprolol	**53300**	5.22	9.80E-05		5.12	9.61E-05	6.65	1.25E-04	12.0	2.25E-04	13.5	2.54E-04	35.6	0.001	25.1	4.72E-04			81.0	0.002	13.6	2.54E-04	11.7	2.20E-04	65.3	0.001	fass.se
Naproxen	**640**	52.5	0.082		162	0.254	73.2	0.114	140	0.218	192	0.301	0.79	0.001	0.36	0.001			< 1.05	-	10.6	0.017	121	0.190	182	0.284	fass.se
Paracetamol	**50000**	847	0.017		854	0.017	< 20.8	-	366	0.007	705	0.014	4030	0.081	2580	0.052	2060	0.041	7150	0.143	799	0.016	1050	0.021	2050	0.041	fass.se
	9200	847	0.092		854	0.093	< 20.8	-	366	0.040	705	0.077	4030	0.438	2580	0.280	2060	0.224	7150	0.777	799	0.087	1050	0.114	2050	0.223	fass.se
Paroxetine	**NA**	0.34	NA		0.20	NA	2.33	NA	0.32	NA	4.59	NA	1.34	NA	2.08	NA		NA	< 1.51	NA	0.27	NA	8.95	NA	14.9	NA	
Perindopril	**NA**	< 2.08	NA		< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	1.84	NA	< 2.08	NA	< 2.08	NA	0.66	NA	< 2.08	NA	< 2.08	NA	1.18	NA	
Perindoprilat	**NA**	< 2.08	NA		< 2.08	NA	< 2.08	NA	0.30	NA	0.29	NA	0.99	NA	< 2.08	NA	< 2.08	NA	0.26	NA	< 2.08	NA	< 2.08	NA	1.33	NA	
Sertraline	**56**	0.60	0.011		0.30	0.005	0.94	0.017	0.46	0.008	3.35	0.060	2.27	0.041	< 0.42	-			0.07	0.001	0.20	0.003	2.94	0.053	1.91	0.034	fass.se
Simvastatin	**9600**	< 20.8	-		< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	fass.se
Sulfamethizole	**NA**	< 20.8	NA		< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	fass.se
Venlafaxine	**4800**	2.62	5.45E-04		2.40	5.01E-04	10.4	0.002	10.8	0.002	14.9	0.003	64.7	0.013	102	0.021			66.1	0.014	2.13	4.43E-04	13.8	0.003	74.6	0.016	fass.se
Warfarin	**11000**	< 0.8	-		< 0.8	-	0.83	7.52E-05	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-			< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	fass.se
Zopiclone	**NA**	< 20.8	NA		< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	-	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	
PCP	***µg/l***																										
EDTA	**9**	1.80	0.200				2.90	0.322	2.50	0.278			1.10	0.122	42.0	4.7			63.0	7.0	3.70	0.411	1.40	0.156	56.0	6.2	Schlabach et al., 2007
EDTA (2)																											
Diethylphthalate	**3.65**	0.053	0.014				0.077	0.021	0.047	0.013			0.028	0.008	0.207	0.057			0.017	0.005	0.086	0.024	0.073	0.020	0.051	0.014	Schlabach et al., 2007
Butylparaben	**0.404**	0.002	0.005				0.005	0.013	0.004	0.009			0.001	0.003	0.008	0.020			0.002	0.006	0.011	0.027	0.001	0.003	0.005	0.012	Schlabach et al., 2007
SDS	**20**	0.420	0.021				0.200	0.010	0.180	0.009			0.560	0.028	0.240	0.012			0.130	0.007	0.096	0.005	0.220	0.011	0.079	0.004	Schlabach et al., 2007
SDSEO1-4	**1**	6.700	6.7				0.550	0.550	0.084	0.084			3.300	3.3	33.00	33			12.00	12	45.00	45	0.130	0.130	3.600	3.6	Schlabach et al., 2007
CAPB	**0.02**	0.550	28				0.100	5.0	0.036	1.8			<0.085	-	8.500	425			4.700	235	8.900	445	<0.2	-	<0.084	-	Schlabach et al., 2007
ATAC-C16	**0.01**	0.299	30				0.155	15.5	0.690	69			1.056	106	0.340	34			2.879	288	0.376	38	3.1	310	0.520	52	Schlabach et al., 2007

Recipient waters

Calculated risk factors and concentrations of pharmaceuticals (ng/L) and additives of personal care products (µg/L)

		Town		Hospitals								Capitals														
		Kláksvík FO		Main Hospital FO		Main Hospital 2010 GL		Main Hospital 2011 GL		Hospital Klaksvík FO		Kolonihavnen GL		Iggia 2010 GL		Iggia 2011 GL		Tórshavn FO		Tórshavn marina FO		Tórshavn shipyard FO		
Compounds	PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	MEC	MEC/PNEC	References
Pharmaceuticals	***ng/L***																							
Salicylic acid	**90000**	< 41.7	-	88.8	9.87E-04	< 41.7	-	< 41.7	-	< 41.7	-	< 41.7	-	6048	0.067	1048	0.012	265	2.95E-03	< 41.7	-	< 41.7	-	fass.se
Amiloride	**NA**	552	NA	53.0	NA	238	NA	< 3.03	NA	552	NA	390	NA	398	NA	303	NA	343	NA	69.3	NA	486	NA	
Amlodipine	**280**	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	fass.se
Atenolol	**NA**	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	
Bendroflumethiazide	**23000**	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	1.23	5.36E-05	< 0.42	-	1.39	6.04E-05	< 0.42	-	< 0.42	-	fass.se
Candesartan	**12**	< 2.08	-	3.92	0.327	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	5.34	0.445	< 2.08	-	< 2.08	-	Kümmerer and Hempel,
Citalopram	**8000**	0.61	7.64E-05	2.59	3.24E-04	< 0.42	-	0.50	6.28E-05	0.61	7.64E-05	< 0.42	-	1.13	1.41E-04	6.25	7.82E-04	4.28	5.35E-04	< 0.42	-	< 0.42	-	Besse et al., 2008
Diclofenac	**100000**	1.84	1.84E-05	8.41	8.41E-05	2.42	2.42E-05	17.3	1.73E-04	1.84	1.84E-05	9.11	9.11E-05	30.1	3.01E-04	10.6	1.06E-04	6.54	6.54E-05	2.72	2.72E-05	1.45	1.45E-05	fass.se
Dipyridamole	**NA**	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	< 16.05	NA	
Enalapril	**NA**	0.19	NA	4.40	NA	< 0.10	NA	< 0.10	NA	0.19	NA	< 0.10	NA	0.25	NA	2.98	NA	5.87	NA	< 0.10	NA	0.37	NA	
Enalaprilat	**NA**	< 2.34	NA	10.7	NA	< 2.34	NA	3.27	NA	< 2.34	NA	< 2.34	NA	< 2.34	NA	8.59	NA	8.97	NA	< 2.34	NA	< 2.34	NA	
17β-Estradiol	**0.80**	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	fass.se
Estriol	**0.75**	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	Schlabach et al., 2007
Estrone	**NA**	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	< 3.73	NA	
17α-Ethinylestradiol	**0.10**	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	< 208	-	fass.se
Fluoxetine	**110**	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	fass.se
Furosemide	**45140**	< 4.17	-	6.69	1.48E-04	< 4.17	-	< 4.17	-	< 4.17	-	< 4.17	-	48.6	1.08E-03	< 4.17	-	30.8	6.82E-04	< 4.17	-	< 4.17	-	fass.se
Glicazide	**NA**	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	
Hydrochlorothiazide	**100000**	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	fass.se
Ibuprofen	**7100**	10.2	1.44E-03	70.3	9.91E-03	< 0.42	-	0.98	1.38E-04	10.2	1.44E-03	1.25	1.76E-04	872	0.123	120	0.017	130	0.018	3.03	4.27E-04	3.59	5.05E-04	fass.se
Levothyroxine	**497000**	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	< 1.61	-	fass.se
Lidocaine	**106000**	< 0.42	-	8.40	7.92E-05	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	0.43	4.07E-06	0.86	8.13E-06	4.84	4.57E-05	< 0.42	-	0.48	4.56E-06	Kümmerer and Hempel,
Losartan	**331000**	< 2.08	-	4.06	1.23E-05	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	< 2.08	-	5.03	1.52E-05	4.60	1.39E-05	< 2.08	-	< 2.08	-	fass.se
Metformin	**101000**	< 2.08	-	61.4	6.08E-04	< 2.08	-	748	7.41E-03	< 2.08	-	< 2.08	-	33.1	3.27E-04	62.3	6.17E-04	77.9	7.71E-04	< 2.08	-	< 2.08	-	Kümmerer, 2004
Metoprolol	**53300**	2.82	5.30E-05	11.2	2.10E-04	< 0.5	-	< 0.5	-	2.82	5.30E-05	< 0.5	-	2.16	4.05E-05	10.1	1.90E-04	23.7	4.45E-04	< 0.5	-	1.69	3.16E-05	fass.se
Naproxen	**640**	< 1.05	-	< 1.05	-	< 1.05	-	< 1.05	-	< 1.05	-	< 1.05	-	45.9	0.072	< 1.05	-	5.76	9.01E-03	< 1.05	-	< 1.05	-	fass.se
Paracetamol	**50000**	42.3	-	931	0.019	< 20.8	-	< 20.8	-	42.3	8.46E-04	< 20.8	-	164	3.29E-03	698	0.014	599	0.012	< 20.8	-	< 20.8	-	fass.se
	9200	42.3	-	931	0.101	< 20.8	-	< 20.8	-	42.3	4.60E-03	< 20.8	-	164	0.018	698	0.076	599	0.065	< 20.8	-	< 20.8	-	fass.se
Paroxetine	**NA**	< 1.51	NA	< 1.51	NA	< 1.51	NA	1.76	NA	< 1.51	NA	< 1.51	NA	< 1.51	NA	< 1.51	NA	< 1.51	NA	< 1.51	NA	< 1.51	NA	
Perindopril	**NA**	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	
Perindoprilat	**NA**	< 2.08	NA	2.36	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	< 2.08	NA	2.91	NA	2.49	NA	< 2.08	NA	2.54	NA	
Sertraline	**56**	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	< 0.42	-	fass.se
Simvastatin	**9600**	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	< 20.8	-	fass.se
Sulfamethizole	**NA**	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	fass.se
Venlafaxine	**4800**	0.94	1.95E-04	7.09	1.48E-03	< 0.42	-	< 0.42	-	0.94	1.95E-04	< 0.42	-	0.54	1.13E-04	5.58	1.16E-03	7.92	1.65E-03	< 0.42	-	< 0.42	-	fass.se
Warfarin	**11000**	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	< 0.8	-	fass.se
Zopiclone	**NA**	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	< 20.8	NA	
PCP	***µg/l***	µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		
EDTA	**9**	1.6	0.18	1.8	0.20	< 0.3	NA	< 0.3	NA	1.6	0.18	< 0.3	NA	< 0.3	NA	1	0.14	1	0.14	< 0.3	NA	< 0.3	NA	Schlabach et al., 2007
EDTA (2)																								
Diethylphthalate	**3.65**	< 0.03	NA	0.045	0.01	< 0.03	NA	< 0.04	NA	< 0.03	NA	< 0.04	NA	< 0.03	NA	< 0.04	NA	0.14	0.04	< 0.03	NA	< 0.03	NA	Schlabach et al., 2007
Butylparaben	**0.404**	<0.007	NA	0.010	0.02	<0.006	NA	<0.008	NA	<0.007	NA	<0.008	NA	<0.006	NA	<0.008	NA	0.01	0.02	<0.006	NA	<0.005	NA	Schlabach et al., 2007
SDS	**20**	0.13	0.01	0.25	0.01	0.04	0.002	<0.035	NA	0.13	0.01	0.082	0.004	0.038	0.002	0.41	0.02	0.19	0.01	0.13	0.01	0.081	0.004	Schlabach et al., 2007
SDSEO1-4	**1**	0.28	0.28	0.42	0.4	<0.16	NA	<0.16	NA	0.28	0.3	<0.16	NA	0.34	0.34	19	19	2.2	2	0.4	0.4	0.37	0.4	Schlabach et al., 2007
CAPB	**0.02**	0.27	14	0.27	14	<0.082	NA	<0.083	NA	0.27	14	0.1	5	<0.084	NA	7.5	375	0.58	29	0.14	7.0	0.44	22	Schlabach et al., 2007
ATAC-C16	**0.01**	<0.38	NA	1.4	136	<0.35	NA	<0.36	NA	<0.38	NA	0.35	35	<0.36	NA	0.9	88	1.65	165	<0.37	NA	<0.37	NA	Schlabach et al., 2007

RESULTS II

Pharmaceuticals

Diluted effluents

- For *candesartan*: ratios >1 at two locations in the Faroe Islands
  - → **risk to the aquatic environment around the WWTP effluent pipe outlet**
- Other pharmaceuticals with ratios < or ≤ 1
  - → **no risks to the aquatic environment**

Recipient waters

- For *candesartan*: indication for a small margin only to a level where inacceptable risk from candesartan is expected
- Other pharmaceuticals with ratios < or ≤ 1
  - → **no risks to the aquatic environment**

Hormones

Diluted effluents

- Risk ratios for *17β-estradiol* at 31 and higher
- *Estriol* risk ratios from 3 to 7.7 at six locations and even higher ratios from 10.1 up to 26.4 at four locations
  - → **chronic risk for organisms staying and/or living around WWTP effluent pipe-outlets**

Recipient waters

Concentrations and PNECs were below the LOD for *17β-estradiol*, *estriol* and *17α-ethinylestradiol* which is a limitation for interpretation

Additives in personal care products

Diluted effluents

- Risk ratios > 1 for *EDTA* in 3 samples and *sodium laureth sulphate* (*SDEO1-4*) in 6 samples
- *Risk ratios > 1 for cocoamidopropyl betaine* (*CAPB*) and up to 445 in 6 samples
- Risk ratios > 10 for *cetrimonium salt* (*ATAC-C16*) in all samples with ratios up to 310
  - → **risks for chronic toxicity in the environment**

Recipient waters

- Risk ratios exceeding 1 in 8 of the 11 samples due to *CAPB ATAC-C16* and in one sample also due to *SDEO1-4*
- At 3 locations an overall high risk (MEC/PNEC>100) of *CAPB* and *ATAC-C16*
  - → **risks for chronic toxicity in the environment**

Limitations *(and recommendations for follow up studies)*

- Snapshot samples *(at least 24h samples)*
- Low number of samples from each site *(repeated sampling)*
- Recipient waters from Iceland were missing *(analysis of recipient waters)*
- For 12 of the 37 analysed phamaceuticals were no PNEC-values available *(need for PNEC data)*
- Sediment samples were not included for risk assessment since PNEC data only exist for water *(need for PNEC data)*

Conclusions

A high dilution of WWTP effluents discharged into recipient waters minimises the risks of pharmaceuticals for the aquatic organisms.

The potential ecological risk stemming from discharge of surfactants as used in household and industrial detergents and additives in personal care products from these analysed areas, demonstrates a need for follow-up studies on surfactant concentration in the recipients.

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