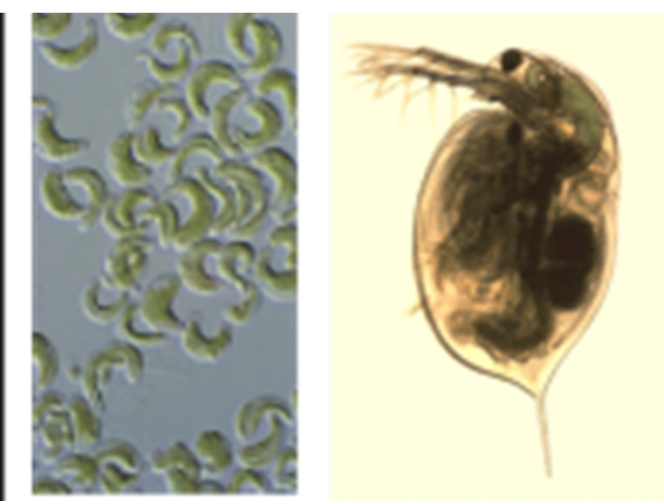
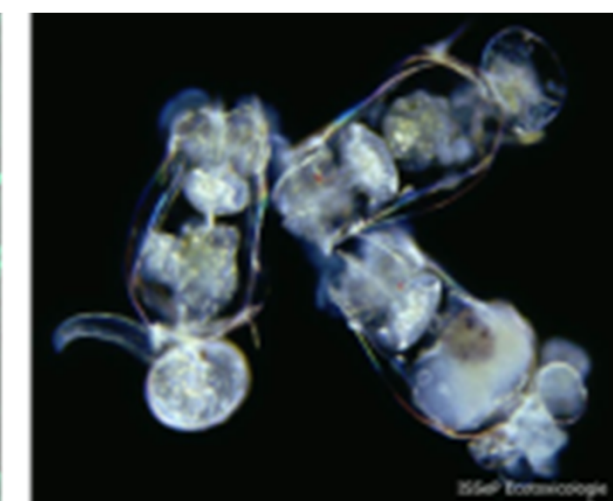
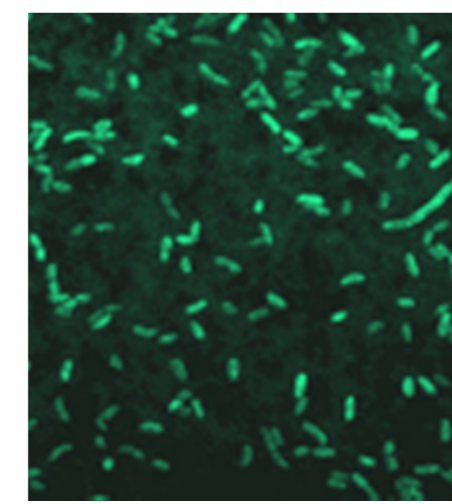
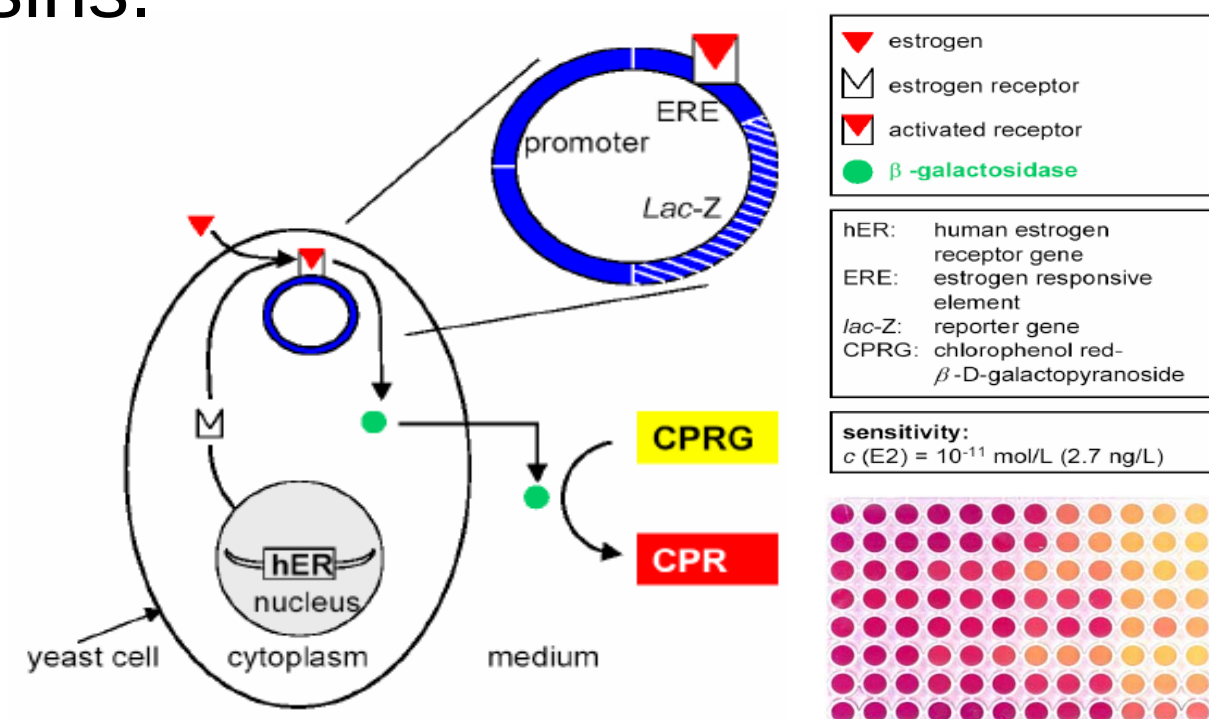


Introduction

A study was carried out with complementary tools in different rivers of the Meuse and Scheldt basins, upstream, downstream and in the effluent of selected industries and urban wastewater treatment plants. An active monitoring using laboratory bioassays was carried out, combining ecotoxicological and physico-chemical measurements. Besides a standard battery of bioassays, a special attention was paid to the presence of endocrine disrupting compounds. Indeed, in wastewaters and surface waters, they have become a major concern worldwide, since they negatively affect wildlife and humans.

Materials and methods

36 major industrial discharges and 20 sampling points in the receiving waters (upstream and downstream of the effluent) were sampled in the Meuse and Scheldt basins.

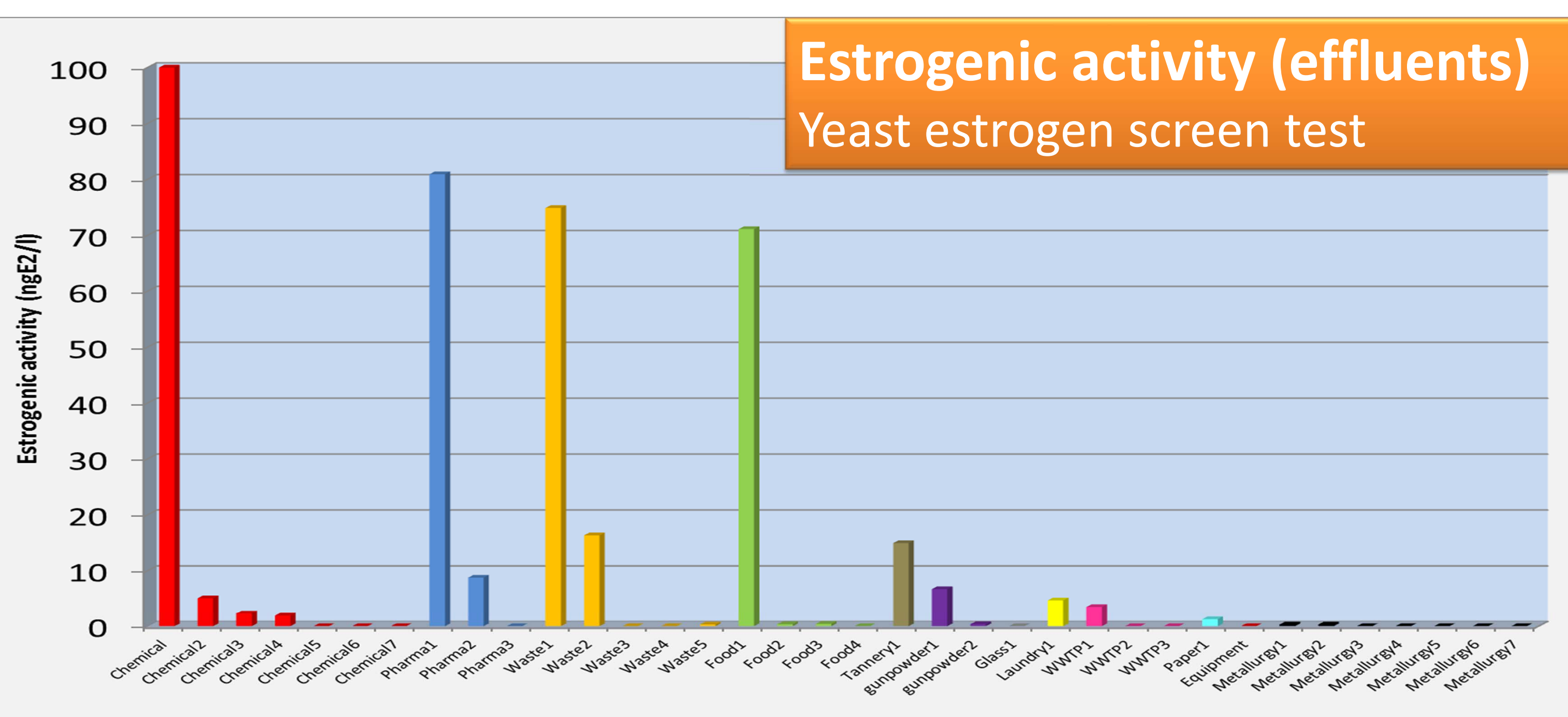


Moreover, we used a battery of short term and chronic bioassays with the bacteria *Vibrio fischeri*, the alga *Pseudokirchneriella subcapitata*, the rotifer *Brachionus calyciflorus* and the microcrustacea *Daphnia magna* to assess their overall toxicity

Polar organic chemical integrative samplers (POCIS) were also used at some locations to sample hydrophilic compounds such as pharmaceuticals, personal care products, hormones, and pesticides having low log *n*-octanol-water partition coefficients (K_{ow} < 3). POCIS extracts were screened for the presence of estrogenic chemicals using the yeast estrogen screen (YES) assay.

A yeast estrogen screen (YES) assay was conducted as effective first-tier screening tool to assess the estrogenic potential of surface water or effluent samples.

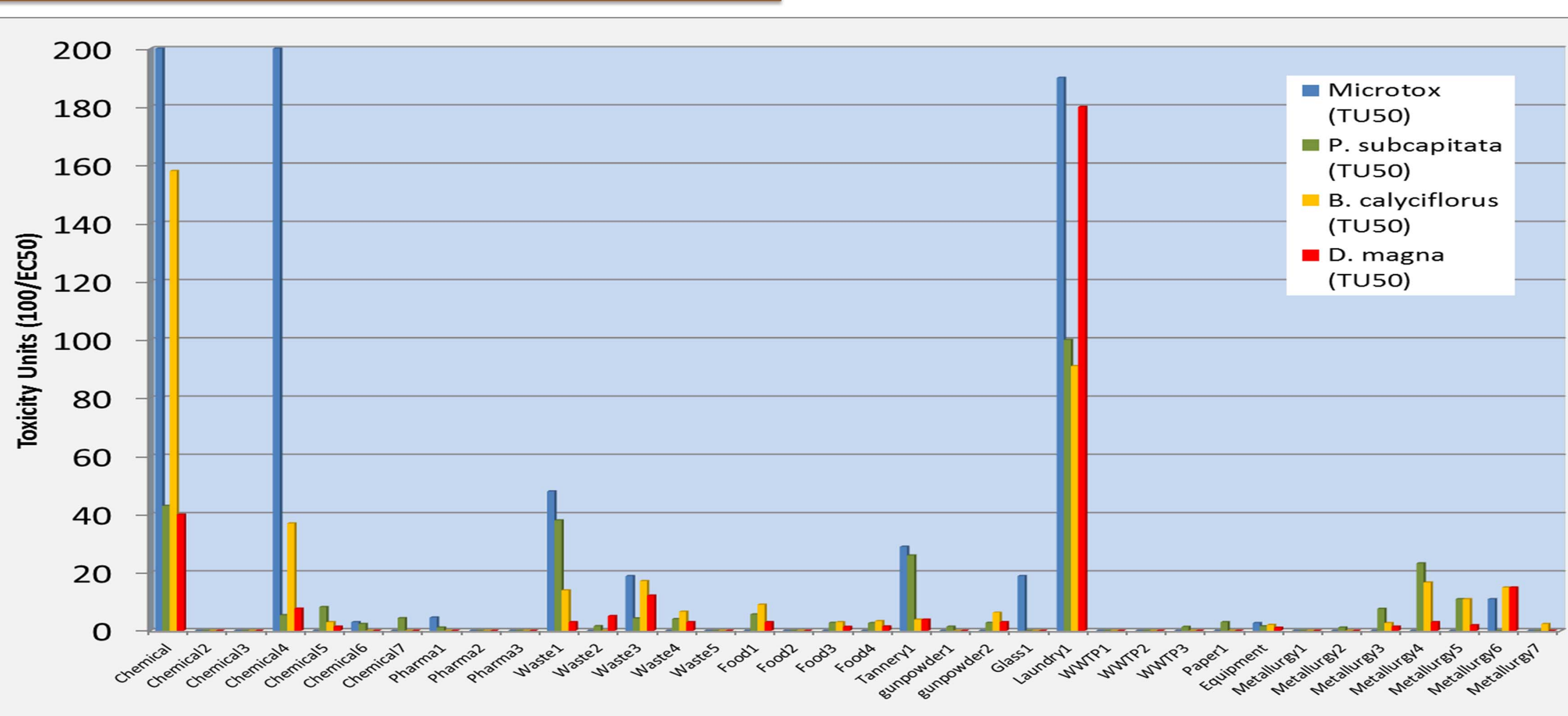
Results and discussions



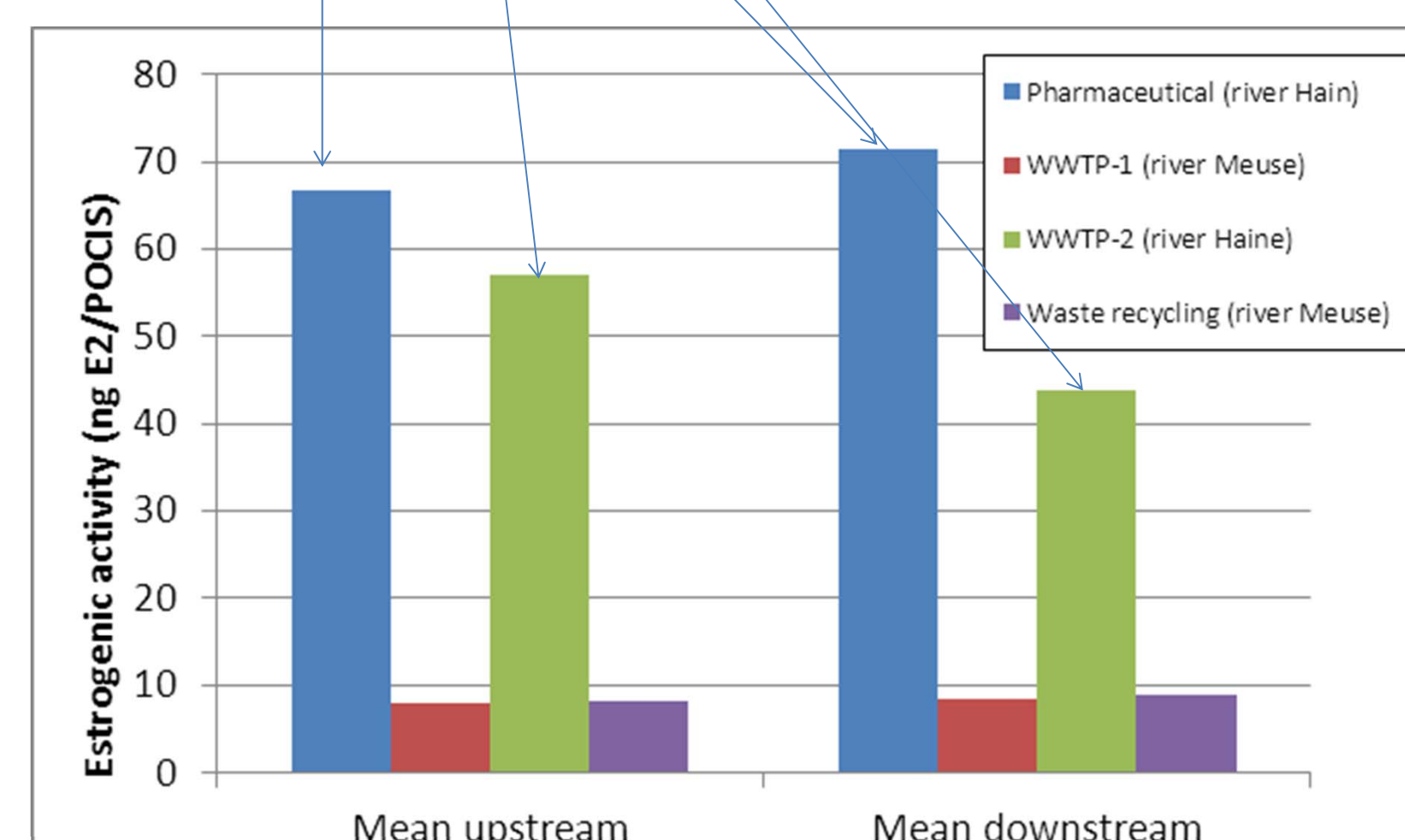
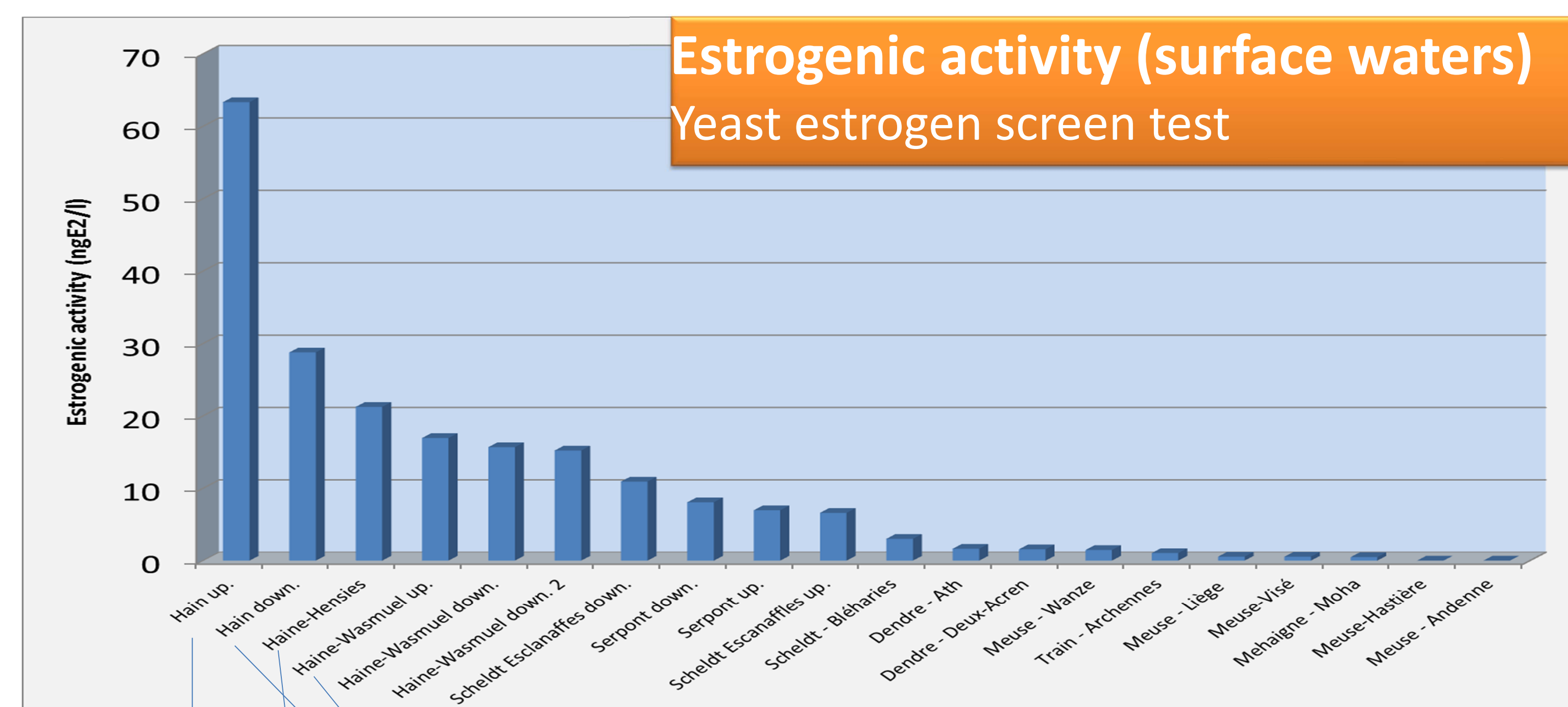
The results of the Yeast estrogen screen test show that 17 effluents (50%) exhibited estrogenic activities > 1ngE2 eq/l. Very high estrogenic activities (> 70 ngE2 eq/l) were found in 4 industrial effluents (chemical, pharmaceutical, waste and food industries); 5 other effluents induced estrogenic activity > 5 ngE2 eq/l.

Overall toxicity (effluents)

Standard test battery



Amongst the 36 industrial effluent samples, 3 were classified as extremely toxic (>100 TU50), 6 as very toxic (10-100 TU50), 15 as toxic (1-10 TU50), 2 as weakly toxic (< 1 TU50) and 10 as not toxic (0 TU50). Chemical industry and laundry effluents (galvanizing) were particularly toxic for *Daphnia magna*, *algae* and *Brachionus calyciflorus* (discharge in River Vesdre). *Vibrio fischeri* appear to be very sensitive to surfactant and waste treatment effluent. Species used in the battery give complementary information



Estrogenic activity (Pocis)

Yeast estrogen screen test

With the differences observed in water samples originating from small and large rivers respectively.

Approved and suspected estrogenic compounds were detected in the POCIS extracts (qualitative analyse by gas chromatography/mass spectrometry (GC/MS).

Group	Substance	Peak area ratio downstream/upstream			
		Pharma	WWTP-1	WWTP-2	Waste recycling
Plastic monomer	Bisphénol A	0.95	1.25	0.8	1.3
	Estrone	0.99	-	0.77	-
Hormone	17β-estradiol	-	-	0.64	-
	Triclosan	1.38	1.48	0.81	0.99
Pesticide	Cis-Propiconazole	0.88	1.2	0.73	1.55
	Trans-Propiconazole	0.84	1.33	0.84	1.36
	Atrazine	0.86	1.05	0.98	0.98
Cosmetic preservative	Méthylparaben	1.33	-	-	-
	Ethylparaben	1.41	-	-	-
	Propylparaben	1.29	-	-	-
UV filter	Benzophénone-1	1.12	-	-	0.88
	Benzophénone-3	1.99	-	-	-

Conclusion

One third of the studied effluents exhibited high estrogenic activity levels and two third an important overall toxicity. These effluents are directly discharged in surface water bodies and the results indicate a higher vulnerability of the small rivers with higher estrogenicity levels than in the large ones. 50 % of the surface water samples showed estrogen equivalency above the concentration (4 ngE2/L) that feminizes fathead minnows (Lange et al. 2001). The results obtained on water samples were in good accordance with the measurements in POCIS extracts (between 40 and 80 ng E2 eq/POCIS in the smaller rivers Haine and Hain and between 6 and 11 ng E2 eq/POCIS in the larger river Meuse). These values are also in good accordance with other studies: Alvarez *et al.* (2008) found estrogenic activities between 14 and 79 ng E2 eq/POCIS on POCIS placed in two rivers. Vermeirssen *et al.* (2005) found activities between 2 et 65 ng E2 eq/POCIS on POCIS placed downstream from WWTP in rivers of Switzerland. The qualitative chemical screening on POCIS extracts confirmed the presence of estrogenic compounds.