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Biota monitoring under the Water Framework Directive: Influence of fish species and tissue choice on levels of priority substances

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This study addresses the topics of fish species selection and choice of suitable matrices in biota monitoring and the effects of data normalization on substance concentrations. As a bridging study it will also allow a better interpretation of present and retrospective monitoring data of the German Environmental Specimen Bank as well as those of other programs (e.g., monitoring data of the German federal states).
Fish of different trophic levels (bream, *Abramis brama*, n=11), chub (*Squalius cephalus*, n=28), and perch (*Perca fluviatilis*, n=19) were sampled at one site in the German Danube. The priority substances mercury (Hg), dioxins, furans and dioxin-like polychlorinated biphenyls (PCDD/F + dl-PCB; in addition also non-dioxin-like (ndl)-PCB), polybrominated diphenyl ethers (PBDE), hexabromocyclododecane (HBCD), hexachlorobenzene (HCB), and perfluorooctane sulfonic acid (PFOS) were analyzed separately in fillet and carcass. These data were used to calculate whole body concentrations. Hg was analyzed in individual fish fillets and carcasses, all other substances were determined in pooled samples of fillets respectively carcasses (1 bream pool, 2 perch pools, 3 chub pools, respectively). In accordance with the EU Guidance document No. 32, the data were normalized to lipid weight (or dry mass in the case of Hg and PFOS) for comparison between species.
The EQSs for Hg and PBDE were exceeded by all samples while general compliance was observed for HBCD and HCB. For PCDD/F + dl-PCB and PFOS, EQS compliance varied between samples. Hg concentrations were generally higher in fillet than in whole fish (factor 1.2 - 1.9). Highest levels of up to 509 µg/kg wet weight were detected in fillets of perch (piscivorous fish). In contrast, PCDD/F+dl-PCB, ndl-PCB, PBDE, HBCD, HCB and PFOS were mostly higher in whole fish than in fillet. In the case of lipophilic substances these differences leveled after lipid normalization. Lipid fractions of fillet and carcass differed between species with carcass/filet factors of 2.4 - 3.8 in bream and chub and 8.9 in perch.
Based on individual fish data of chub and perch, significant correlations ($p < 0.05$ or better) were detected between Hg levels in fillet, carcass and whole fish and fish length, fillet weight, carcass weight, whole fish weight and age. No such correlations were detected for bream which is probably related to the relatively small sample size. For the pool samples significant correlations ($p < 0.05$) were detected between the lipid content and concentrations of PCDD/F, dl-PCB, ndl-PCB, PBDE, HCBD and HCB in whole fish and in carcasses. In fillets, lipid fractions correlated with HBCD and HCB but not with PBDE, PCDD/F and PCB concentrations.
The uneven distribution of body lipids in fish implies that basing risk assessment on ‘face values’ in fillet would largely underestimate the risk for piscivorous predators in the case of lipophilic substances.

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