# PFAS in biota – new needs and requirements

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# New EFSA TWI value

- Final scientific opinion 17 Sep 20: 4.4 ng/kg BW per week
- PFAS put in connection with several effects:
  - Thyroid gland, liver, fat metabolism (cholesterol), hormones and immune system at longterm exposure, vaccination response, reproductive disorder
- Large decrease in EFSAs TWI (tolerable weekly intake) value
- Governing factor: worse response at vaccination of children. Both antibodies and T-cells.
- TDI became TWI to reflect bioaccumulation
- Sum of 4 PFAS: PFOA, PFNA, PFHxS and PFOS. Similar in blood and toxicity (vs vaccination)
- Old TDI PFOS 150, PFOA 1500 ng/kg BW/day (240-2400x diff)
- Greatest exposure through foodstuffs, especially fish, fruit and egg

# New EFSA TWI value

- Current Water Framework Directive EQS value for PFOS (fish muscle): 9.1 µg/kg FW with TDI = 150 ng/kg BW/day
- $QS_{biota,hh}$ = (0.1 x TL x 70)/0.115 (TL=TDI)
- If new TWI is used an EQS value of 38 ng/kg FW is obtained for PFAS4
  - Consequently, a level of around 10 ng/kg FW for each PFAS could be relevant
- Also the revised drinking water directive put further light on intake of PFAS
  - PFAS20 limit value 100 ng/l
  - Total PFAS limit value 500 ng/l
- What LOQs can be found in scientific reports?
  - TemaNord 2019:515: typically 40 ng/kg FW (some up to 200)
  - PFAS Tyrifjorden 2018, M-1318, NGI/NIVA, 2019: 100-300 ng/kg FW
  - Env Pollut 2020, 263A, 113721: 3-5 ng/kg FW (Swe and Int foodstuffs)
- What will the PFAS ”picture” look if LOQs are lowered?
- Should we look for precursors also in biota?

# Danish Fish

| PFAS ng/kg ww | Fish muscle | Fish liver |
|---|---|---|
| PFBS | <10 | <10 |
| PFBSA | 11 | 123 |
| PFHxSA | (1,7) | (5) |
| PFHxS | <10 | 35 |
| PFOA | <10 | 11 |
| 6:2 FTS | 10 | <10 |
| PFNA | <10 | 18 |
| FOSA linear | 14 | 40 |
| FOSA-branched | (0,6) | (4,5) |
| PFOS linear | 33 | 794 |
| PFOS-branched | <10 | 66 |
| PFDA | (1,5) | 12 |
| 8:2 FTS | (1,1) | (1) |
| PFUdA | (3,6) | (31) |
| PFDoA | (1,6) | (8,3) |
| PFTrDA | (4,8) | (5) |
| PFTeDA | <10 | <100 |

- Fish muscle and liver
- No known point source
- PFBSA could be detected but not PFBS
- (P)FOSA significant vs PFOS for muscle
- Around 90% linear PFOS/FOSA
- C4-C13 detected
- PFBSA detected in fish from the US, Canada and Netherlands, in all but one case with PFBS <LOQ (Chu et al., EST 2016, 50, 669)
- Additional PFAS analysed <LOQ

= PFBS + precursor
= PFHxS + precursor
= PFOS + precursors
= PFOA + precursor

# Swedish mussels

| PFAS ng/kg ww | Mussels |
|---|---|
| PFBS | <10 |
| PFBSA | 42 |
| PFHxSA linear | 48 |
| PFHxSA-branched | (7,6) |
| PFHxS | (4,9) |
| PFOA | <10 |
| 6:2 FTS | n.a |
| PFNA | (3,0) |
| FOSA linear | 139 |
| FOSA-branched | 47 |
| PFOS linear | 31 |
| PFOS-branched | <10 |
| PFDA | (5,2) |
| 8:2 FTS | (0,8) |
| PFUdA | 11 |
| PFDoA | 16 |
| PFTrDA | 39 |
| PFTeDA | 56 |

- Swedish west coast
- No known point source
- PFBSA could be detected but not PFBS
- (P)FOSA higher than PFOS
- Around 75% linear FOSA
- (P)FHxSA higher than PFHxS
- C4-C14 detected
- Additional PFAS analysed but below LOQ

= PFBS + precursor
= PFHxS + precursor
= PFOS + precursors
= PFOA + precursor

# Swedish Benthic Fauna

| Sample | Benthic fauna |
|---|---|
| µg/kg ww | |
| PFBA | <0.3 |
| PFPeA | 0,17 |
| PFBS | 2,5 |
| PFBSA | 1,8 |
| PFHxA | 0,16 |
| PFHxSA | 0,13 |
| 4:2 FTS | <0.1 |
| PFHpA | <0.1 |
| PFHxS | 0,13 |
| PFOA | 0,13 |
| 6:2 FTS | 0,34 |
| PFNA | 0,017 |
| FOSA | 0,61 |
| PFDA | 0,035 |
| 8:2 FTS | 0,073 |
| PFUdA | 0,039 |
| PFDoA | 0,52 |
| PFTeDA | 1,0 |
| PFHxDA | 0,10 |
| MeFOSAA | <0.1 |
| EtFOSAA | 0,15 |
| PFOS | 1,0 |

- Creek draining industrial area with waste management and landfill
- ”Mixed” organisms
- Concentrations of C4, C6 and C8 sulphonate precursors in the same order as the sulphonates
- Large no of PFAS <0.5 µg/kg FW
- C5-C16 detected
- Invertebrates may not degrade precursors (6:2 FTS) in the same way/extent as in e.g. fish (Langberg et al. EST 2019, 53, 10951)
- Additional PFAS analysed

= PFBS + precursor
= PFHxS + precursor
= PFOS + precursors
= PFOA + precursor

# Norwegian Salmon

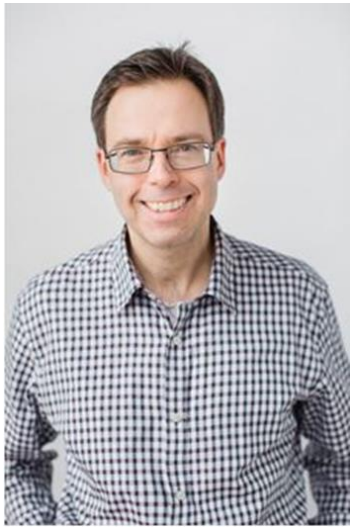
| Sample | Salmon 3 |
|---|---|
| | µg/kg WW |
| 8:2FTOH | <1 |
| GenX | <0.1 |
| PFBA | <0.3 |
| PFBSA | 0,010 |
| PFBS | <0.01 |
| PFHxA | <0.1 |
| PFHxSA | <0.01 |
| PFHxS | <0.01 |
| PFOA | <0.01 |
| 6:2 FTS | 0,11 |
| FOSA | 0,013 |
| PFOS | 0,012 |
| EtFOSA | <0.1 |
| 8:2 FTS | <0.01 |
| MeFOSE | <0.1 |
| EtFOSE | <0.1 |
| PFNA | <0.01 |
| PFDA | <0.01 |
| PFUdA | <0.01 |
| PFDoA | <0.01 |
| PFTrDA | <0.05 |
| PFTeDA | <0.01 |

- Farmed salmon
- PFBSA could be detected but not PFBS
- FOSA and PFOS about same concentration
- Concentrations close to LOQ (besides 6:2 FTS)
- Miljödirektoratet list plus additional precursors shown
- In total 49 PFAS analysed

= PFBS + precursor
= PFHxS + precursor
= PFOS + precursors
= PFOA + precursor

# Thank you for your attention!

- **The lowered TWI will require much lower LOQs**
- **A more complex picture of PFAS emerge**
- **Precursors incl new ones (e.g. amides) can be important**
- **Welcome to contact us!**



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