Heavy metals with special emphasis on methylmercury

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Contaminants in fish and seafood

- Metals
  - mercury (methylmercury)
  - arsenic, cadmium, lead
- Organic contaminants
  - dioxins and dioxin-like polychlorinated biphenyls (PCBs)
  - other persistent organic pollutants
    - e.g. brominated flame retardants

Mercury in fish

- Predominantly methylmercury
  - accumulates in older, larger fish
  - localised in internal organs and muscle
- Fish is the major dietary source of methylmercury

Long-lived predatory fish

$Hg^{+}CH_3$

shark

swordfish

marlin

tuna

[With thanks to Google Images]

Levels of mercury in fish

Fish		Levels of Hg (mg/kg)		
		Oily/non-oily	Max	Mean
Shark	Fresh/frozen	Non-oily	2.2	1.5
Swordfish	Fresh/frozen	Oily	2.7	1.4
Marlin	Fresh/frozen	Oily	2.2	1.1
Tuna	Fresh/frozen	Oily	1.5	0.41
Tuna	Canned	Non-oily	0.71	0.19
Cod	Fresh/frozen	Non-oily	0.1	0.07
Trout	Fresh/frozen	Oily	0.1	0.06
Plaice	Fresh/frozen	Non-oily	0.09	0.06
Salmon	Fresh/frozen	Oily	0.08	0.05
Haddock	Fresh/frozen	Non-oily	0.07	0.04
Sardine	Canned	Oily	0.10	0.04

Examples taken from UK surveys

Methylmercury - toxicokinetics

- More readily absorbed by the oral route than other forms of mercury
- Crosses the placental and blood brain barriers
- More able to enter fetal brain
- Greater exposure to fetal brain than other forms of mercury following ingestion

Mercury in fish - the risks

- Causes nerve damage
  - fetus is most sensitive as methylmercury more able to enter the brain and affect development
- Other effects at higher levels of exposure
  - On kidney, liver, reproductive and cardiovascular systems
- Neurodevelopment is considered to be the effect occurring at lowest exposures

Provisional Tolerable Weekly Intake (PTWI)

Joint FAO/WHO Committee on Food Additives (JECFA)

	PTWI µg/kg b.w.	Comment
JECFA 1972-2000	3.3	"pregnant women and nursing mothers may be at greater risk"
JECFA 2003	1.6	"sufficient to protect developing fetuses, the most sensitive subgroup"
JECFA 2006	1.6	Life-stages other than the embryo and fetus might be less sensitive. Intakes up to about two times higher would not pose a risk in adults - excluding women of childbearing age, in order to protect the embryo and fetus

Mercury intakes - selected fish

Mercury intake from one weekly 140g portion of fish (µg/kg bw/week), based on UK survey data

Age group	shark	swordfish	marlin	fresh tuna	canned tuna
1.5-4.5 yrs	5.24	4.62	3.79	1.38	0.66
4-6 yrs	4.44	3.90	3.22	1.17	0.56
7-10 yrs	4.17	3.69	3.04	1.10	0.52
11-14 yrs	4.44	3.92	3.21	1.17	0.55
15-18 yrs	2.51	2.21	1.82	0.66	0.31
adult	3.04	2.68	2.20	0.80	0.38

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Managing exposure to contaminants in fish

- Legal limits for some contaminants in fish
- Controls on fish feed to lower levels in farmed fish – not relevant to methylmercury
- No possibility to control diet of wild fish
  - Important to control emissions to the environment
- Surveys to monitor levels of contaminants
- Safety assessments to provide consumer advice

Conclusions

- Methylmercury is present in fish and seafood, mostly at very low levels, but higher in large predatory fish;
- Methylmercury can affect neurodevelopment of the embryo/fetus;
- Risk assessments support consumer advice to protect the child and allow others to benefit from fish consumption
- The possibilities for controlling methylmercury in predator fish are limited
- Controls on emissions have the potential to reduce contamination – in the longer term

Thank you