ISO Fd Food ERA Chair

Safety Quality Traceability

Radionuclides in food and water

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ISO-FOOD
WP 3 and WP4

- WP 3 Research and education
  - P1 Food authenticity
  - P2 Translation of regional isotopic and elemental signatures from natural environment into local food produce
  - P3 Food safety through detection, identification and characterisation of potentially hazardous substances from the environment and intentionally or unintentionally added to the food products
    - H1 metrological support providing validation and standardization of methods where many analytical methods and approaches are not yet standardized and certified reference materials are not available
- WP4 networking and transfer of knowledge
  - Summer school
    - Radiochemistry – radioisotopes in food

Natural and man-made radionuclides

- natural:
  - uranium and thorium and their decay products

- man-made:
  - fision products: Sr-90, Sr-89, Cs-137, I-131, ...
  - activation products: H-3, Cs-134, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, ...

EU Regulation
Radioactive contamination

- Maximum level of radioactive contamination in foodstuffs
- Arrangements for agricultural import following Chernobyl accident
- Arrangements for exporting foodstuffs and feedingstuffs following a nuclear accident
- Early exchange of information in the event of a radiological emergency

- http://europa.eu/legislation_summaries/food_safety/contamination_environmental_factors/index_en.htm

COUNCIL REGULATION No 3954/87

laying down maximum permitted levels of radioactive contamination of foodstuffs and of feedingstuffs following a nuclear accident or any other case of radiological emergency

MAXIMUM PERMITTED LEVELS FOR FOODSTUFFS AND FEEDINGSTUFFS

(Bq/kg or Bq/l)

	Baby foods (1)	Dairy Produce (2) (3)	Other foodstuffs except minor foodstuffs (4)	Liquid foodstuffs (5)	Feedingstuffs (6)
Isotopes of strontium, notably Sr-90		125	750		
Isotopes of iodine notably I-131		500	2 000		
Alpha-emitting isotopes of plutonium and transplutonium elements, notably Pu-239, Am-241		20	80		
All other nuclides of half-life greater than 10 days, notably Cs-134, Cs-137 (7)		1 000	1 250		

In preparation

- On 10 January 2014, the European Commission adopted the
  - Proposal for a Council Regulation laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency
  - Annexes to the Proposal for a Council Regulation laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency

Proposed values

ANNEX I

MAXIMUM PERMITTED LEVELS OF RADIOACTIVE CONTAMINATION OF FOOD

The maximum permitted levels to be applied to food shall be the following:

	Food (Bq/kg)[1]			
	Infant food[2]	Dairy produce[3]	Other food except minor food[4]	Liquid food[5]
Isotopes of strontium, notably Sr-90	75	125	750	125
Isotopes of iodine, notably I-131	150	500	2 000	500
Alpha-emitting isotopes of plutonium and transplutonium elements, notably Pu-239, Am-241	1	20	80	20
All other nuclides of half-life greater than 10 days, notably Cs-134, Cs-137[6]	400	1 000	1 250	1 000

COMMISSION IMPLEMENTING REGULATION (EU) No 322/2014

- of 28 March 2014

- imposing special conditions governing the import of feed and food originating in or consigned from Japan following the accident at the Fukushima nuclear power station

COUNCIL DIRECTIVE 2013/51/EURATOM

- COUNCIL DIRECTIVE 2013/51/EURATOM of 22 October 2013

laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption

Define reference values for each single, the most common natural and man-made radionuclides

COUNCIL DIRECTIVE 2013/51

Derived concentrations for radioactivity in water intended for human consumption (1)

Origin	Nuclide	Derived concentration
Natural	U-238 (2)	3,0 Bq/l
	U-234 (2)	2,8 Bq/l
	Ra-226	0,5 Bq/l
	Ra-228	0,2 Bq/l
	Pb-210	0,2 Bq/l
	Po-210	0,1 Bq/l
Artificial	C-14	240 Bq/l
	Sr-90	4,9 Bq/l
	Pu-239/Pu-240	0,6 Bq/l
	Am-241	0,7 Bq/l
	Co-60	40 Bq/l
	Cs-134	7,2 Bq/l
	Cs-137	11 Bq/l
	I-131	6,2 Bq/l

ANNEX I

PARAMETRIC VALUES FOR RADON, TRITIUM AND ID OF WATER INTENDED FOR HUMAN CONSUMPTION

Parameter	Parametric value	Unit	Notes
Radon	100	Bq/l	(Note 1)
Tritium	100	Bq/l	(Note 2)
ID	0,10	mSv	

- The recommended screening level for gross alpha activity is 0,1 Bq/L.
- The recommended screening level for gross beta activity is 1,0 Bq/L.

WHO Guidelines for Drinking-water Quality

- Chapter 9: Radiological Aspect

- Recommended screening level for gross alpha and beta activities
- Guidance levels for natural and man-made radionuclides

Derived concentrations for radioactivity in water

		EU (2013)	WHO (2011)
Nuclide		(Bq/L)	(Bq/L)
U-238		3,0	10
U-234		2,8	10
Ra-226		0,5	1
Ra-228		0,2	0,1
Pb-210		0,2	0,1
Po-210		0,1	0,1
Recommended dose level of commited annual effective dose due to water consumption		0,1 mSv	0,1 mSv

Why determination of radionuclides?

- the dose coefficients are always related to specific radionuclides. U-238 and Th-232 decay series nuclides have the highest values of dose coefficients.

- Chemical toxicity
  - Uranium as toxic heavy metal
    - WHO (2011): 30 µg/L
    - USA (EPA 2000): 20 µg/L
    - Germany (2006): 2 µg/L (mineral water)

- Radiotoxicity

$^{210}Po > {}^{228}Ra > {}^{210}Pb > {}^{226}Ra > {}^{234}U > {}^{238}U > {}^{224}Ra > {}^{235}U$

ISO-FOOD

- Radionuclides in food and water
  - Development of rapid methods for their determination
    - Low levels in foodstufs
    - Levels in feeding-stuff
    - Levels in marine organizms
  - Calculation of dose assesment due to consumption of various food and water

ISO-FOOD summer school

- Dermination of natural and man-made radionuclides in
  - Water, milk, meat, mussels, fish, vegetables …
- Methods used
  - alpha-particle spectrometry, beta counting, gamma-ray spectrometry, liquid scintillation technique
- Dose assessment calculation for infants, children and adults

ISO-FOOD Opportunities

- Combination of various nuclear techniques
- Combination of radiometric and mass spectrometric measurements
- Focus on determination of radionuclides in samples with complex matrix
  - Amount of the sample
  - Losses during sample preparation
  - Combination different separation procedures
- Determination of isotopic ratios by ICP MS
  - ISOTOPIC RATIOS analysis (“fingerprint”)
  - mother-daughter isotopes