



STUDY OF RADIONUCLIDE IMPURITIES IN ¹⁸F-METIL-CHOLINE: SETUP OF THE MEASUREMENT GEOMETRY FOR HIGH-PURITY GERMANIUM GAMMA-RAY SPECTROMETER

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BACKGROUND

The Positron Emission Tomography (PET) use radiopharmaceuticals labeling with β^+ emitting isotopes.
¹⁸F is the most commonly used radioisotope in PET and is produced in medical cyclotron.
During the bombardment of target of with [¹⁸O]water to produce the radiopharmaceutical ¹⁸F-Metil-Choline, are generated radionuclidic impurities.
For the European Pharmacopoeia these impurities have to be checked before application for human use.

PURPOSE

In this work we have setup the accurate geometry for measurements with HpGe spectrometer to assess radionuclidic impurities generated during the production of ¹⁸F-Metil-Choline.

MATERIALS AND METHODS

High-resolution gamma spectrometry is the most appropriate method to determine gamma-emitting radionuclides, but it needs a correct geometry for the measurement.
Samples from the different steps of production process were collected: [¹⁸O] irradiated water, waste target water, Chromafix cartridge, waste Chromafix water, WCX cartridge, final waste water and ¹⁸F-FMeCh.
The counting of samples was carried out after an appropriate period to allow for the complete decay of ¹⁸F. Liquid samples were analysed by volumetrically diluting an appropriate quantity of each solution (2 ml) with distilled water to a volume of 15 ml.
The cartridges Chromafix and WCX were measured by placing the samples directly over the detector, through a support.
The counting efficiency was established using a certificated standard Amersham, containing ²⁴¹Am, ¹³³Ba and ¹⁵²Eu (beaker Bertocchi 100 ml).
We used Gespecor software to transfer the efficiency calibration from the geometry of standard to the geometry of the samples and the analysis was performed using the GammaVision analysis software

RESULTS

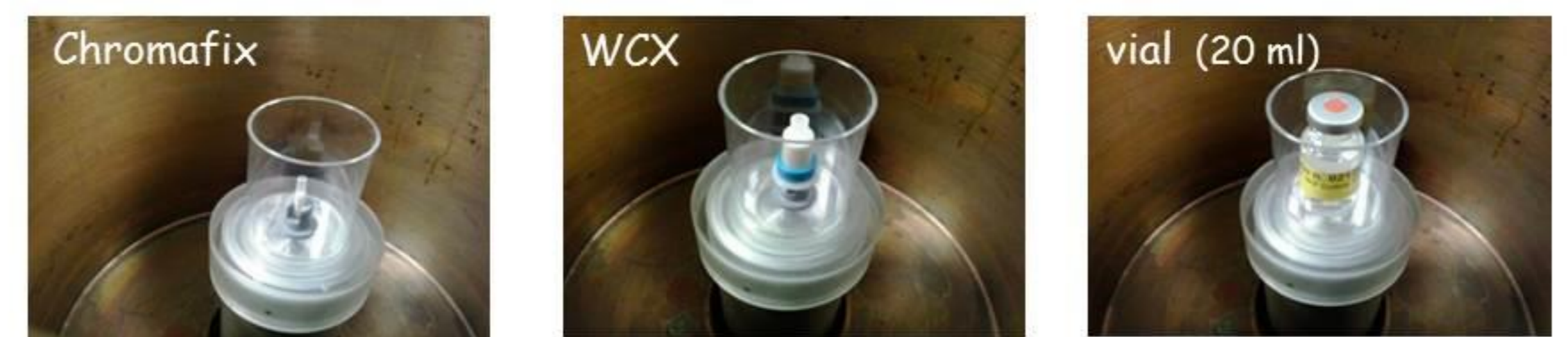
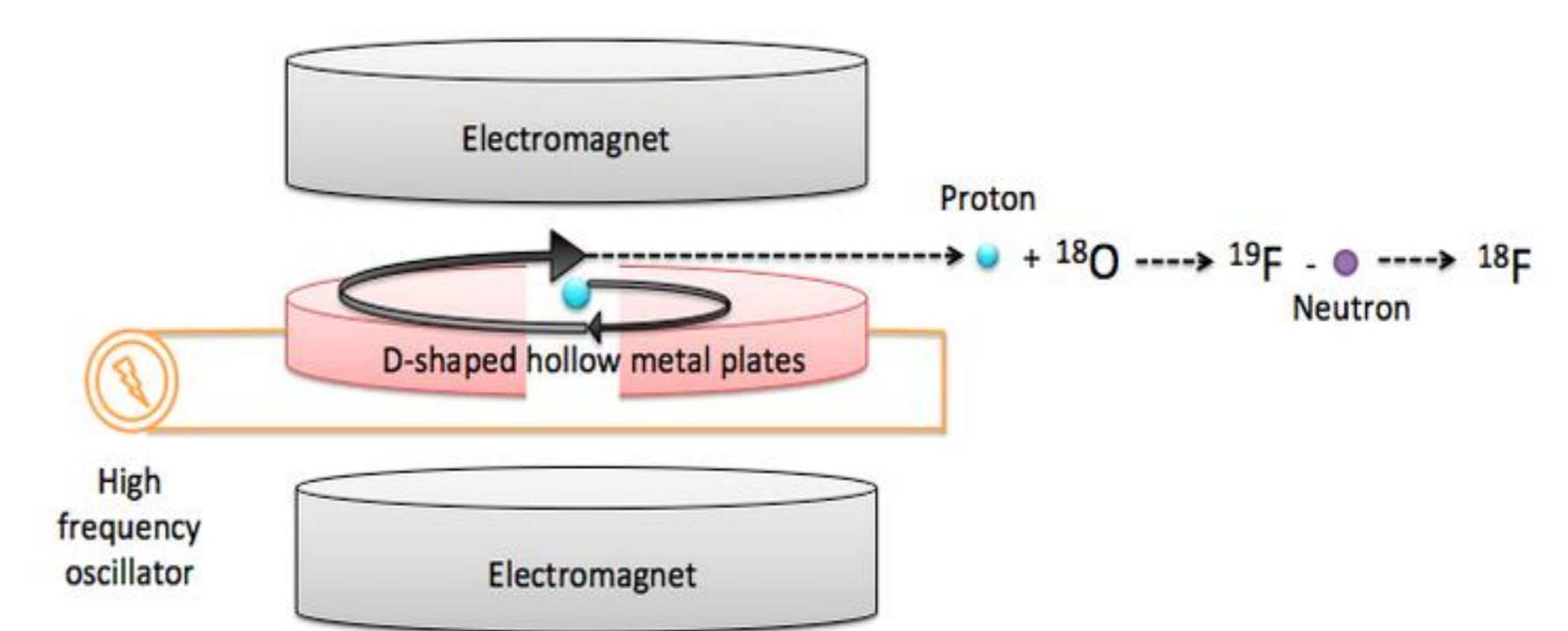
The data showed the presence of gamma-emitting: ⁵¹Cr, ⁵²Mn, ⁵⁴Mn, ⁵⁶Co, ⁵⁷Co, ⁵⁸Co, ^{95m}Tc, ⁹⁶Tc, ¹⁰⁹Cd, ¹⁸⁴Re and ¹⁸⁶Re in the [¹⁸O] irradiated water.
In final ¹⁸F-FMeCh solution, the activity of impurities was lower of the minimum detectable activity of the spectrometer

CONCLUSIONS

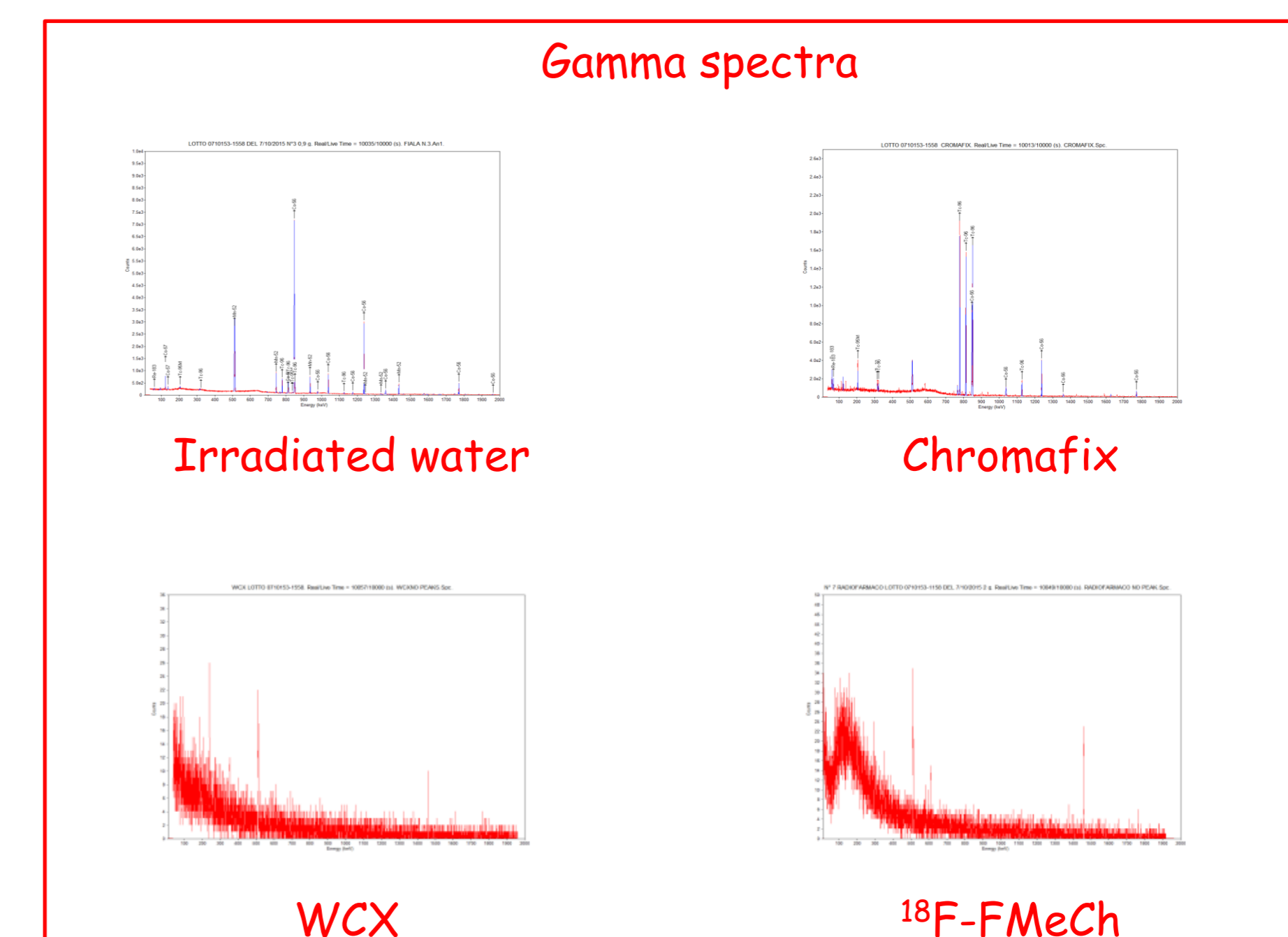
- ✓ The software Gespecor has enabled to determine the radionuclides impurity with a single calibration source and to confirm the radiochemical purity of ¹⁸F-Metil-Choline
- ✓ Contaminants have been identified in all stage of the synthesis process but they were absent in the final product.
- ✓ The purification methods adopted are effective as requested by patient's radiation protection standards and European Pharmacopoeia.

Keywords:

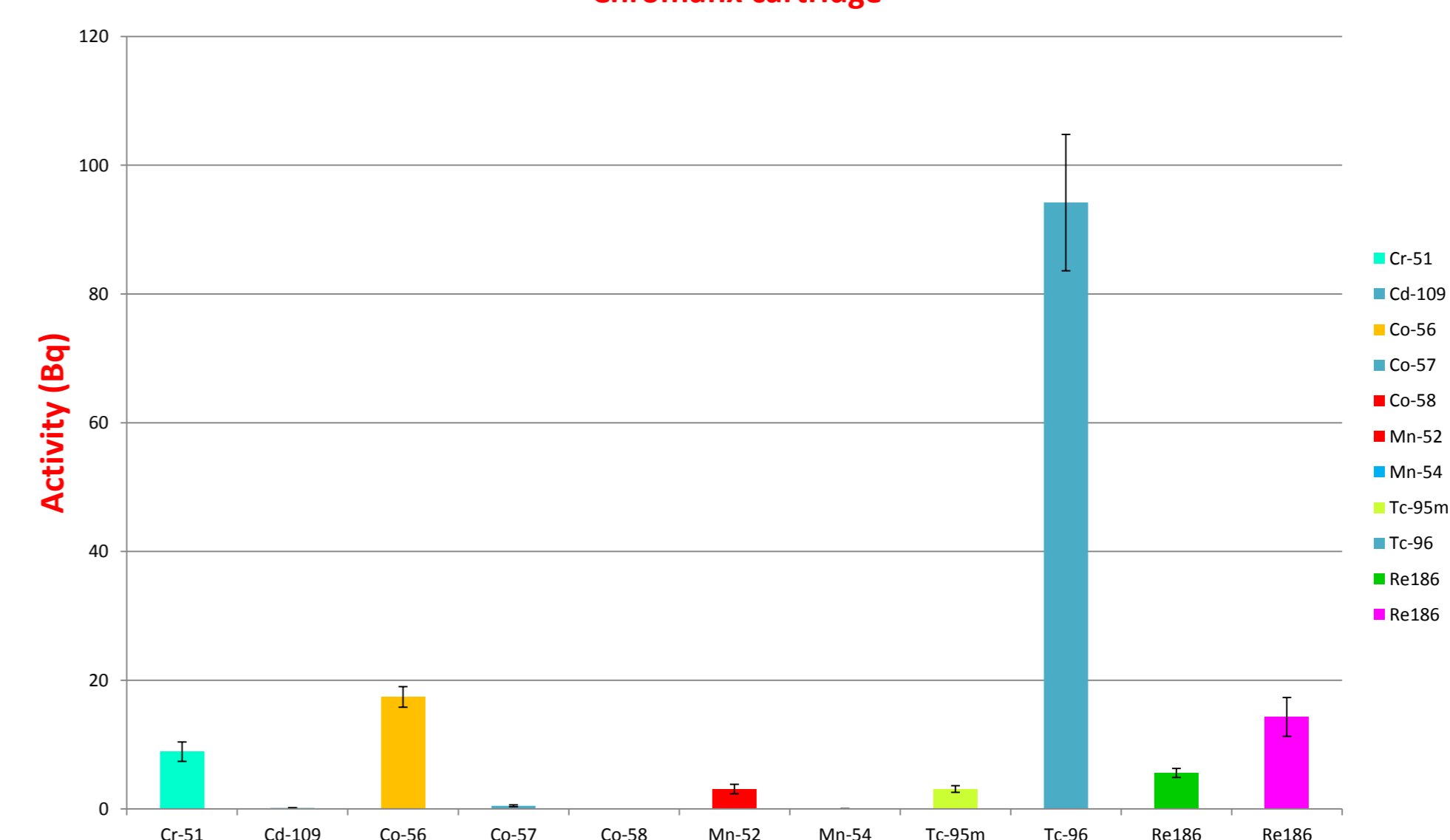
- ✓ Gamma-spectrometry
- ✓ Quality Control
- ✓ Radiopharmacy



Sample geometry



Chromafix cartridge



sample	Cr-51 (Bq/g)	Cd-109 (Bq/g)	Co-56 (Bq/g)	Co-57 (Bq/g)	Co-58 (Bq/g)	Mn-52 (Bq/g)	Mn-54 (Bq/g)	Tc-95m (Bq/g)	Tc-96 (Bq/g)	Re-184 (Bq/g)	Re-186 (Bq/g)
¹⁸ O irradiated water	2,03±0,85	7,5±1,8	354±23	10,3±1,3	3,23±0,97	93±15	38±12	1,18±0,32	40,2±4,4	1,1±0,35	2,2±1,5
target's waste water	<MDA	4,9±1,7	265±19	7,3±0,8	3±0,3	39,4±4,5	1,1±0,3	<MDA	2,5±0,6	0,06±0,04	<MDA
Chromafix waste water	<MDA	7,3±7,6	275±19	6,25±0,63	2,58±0,39	20,6±6,4	1,07±0,34	<MDA	<MDA	<MDA	<MDA
Final waste water	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
¹⁸ F-FMeCh solution	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

sample	Cr-51 (Bq)	Cd-109 (Bq)	Co-56 (Bq)	Co-57 (Bq)	Co-58 (Bq)	Mn-52 (Bq)	Mn-54 (Bq)	Tc-95m (Bq)	Tc-96 (Bq)	Re-184 (Bq)	Re-186 (Bq)
Chromafix cartridge	8,9±1,5	0,16±0,04	17,4±0,18	0,48±0,15	<MDA	3,1±0,75	0,04±0,02	3,1±0,5	94,2±10,6	5,6±0,7	14,3±3
WCX cartridge	<MDA	<MDA	0,47±0,18	<MDA	<MDA	<MDA	<MDA	<MDA	0,26±0,07	<MDA	<MDA

MDA= minimum detectable activity