A new $^{72}Se/^{72}As$ Isotope Generator based on Solid Phase Extraction

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Introduction: The isotope generator $^{72}Se/^{72}As$-system consists of the long-lived mother, ^{72}Se ($T_{1/2}$ = 8.5 d, 100% ε) and the short-lived daughter, ^{72}As ($T_{1/2}$ = 26 h, 88% β^+). Different radiochemical no-carrier added (nca) generator-procedures have been discussed [2,3,4], but due to the complexity and high operating expense they all appeared to be unsuitable for any practical application. So the development of a new and more reliable $^{72}Se/^{72}As$ isotope generator was necessary prior to the development of a new ^{72}As-labelling chemistry.

Isotope: To simulate the behaviour of ^{72}Se, ^{75}Se was used, which was produced via (n,γ)-reaction at the nuclear research reactor at the HMI Berlin. The ^{72}Se itself was produced at the Forschungszentrum Juelich via (^3He,3n)-reaction on natural germanium at a beam current of 5 µA for 12 h, giving a yield of 5 mCi.

Experimental: 100 mg of irradiated natural germanium are dissolved in 5 ml $HF_{conc.}$ and 500 µl $HNO_{3conc.}$ at T = 50°C within 3 hours. Aliqouts of 100 µl were added to 5 mg of hydrazine hydrochloride in 900 µl $HF_{conc.}$ and the mixture was allowed to stir for 30 min.
An ENV-solid phase-extraction cardrige was preconditioned with 5 ml of MeOH, 5 ml H_2O and 5 ml $HF_{conc.}$. Then the mixture was transferred to the cartridge. $^{72}Se^{(0)}$ is fixed to the solid phase, while Ge is eluted with the mobile phase as $[GeF_6]^{2-}$. The produced daughter ^{72}As in nca form can be eluted using $HF_{conc.}$.
To this eluent, 10 mg KI were added and the mixture was stirred for 10 min at room temperature.
To obtain an HF-free solution of nca ^{72}As in an organic solvent, according to the procedure described in [1] nca $^{72}AsI_3$ is produced and separated by a second ENV solid phase extraction cartridge.

Results and Discussion: The concept of the new generator is based on the reduction of the in-target produced ^{72}Se to $^{72}Se^{(0)}$ with hydrazine hydrochloride. This metallic selenium can be fixed by a standard solid phase extraction system based on a Polystyrol matrix.
The daughter is eluted by different solvents and gives the following yields:

$HF_{conc.}$:	52 %
H_2O:	58 %
NH_3, pH=11.5	31 %
H_3PO_4, 1%	33 %

For following radiopharmaceutical synthesis the arsenic has to be transformed in a chemical form which is most suitable for the application desired.
With the procedure developed in [1] a method was chosen which yields $^{72}AsI_3$ in unpolar organic solvent.

The generator characteristics of the new developed system are:

- Yield of fixed selenium:	> 99%
- Yield of eluted arsenic:	> 50%
- selenium remaining in product fraction:	< 0.01%
- duration of set up:	1 h
- duration of elution:	30 min

To illustrate the radionuclidic purity of the ^{72}As eluate, Figs. 1 and 2 are shown:

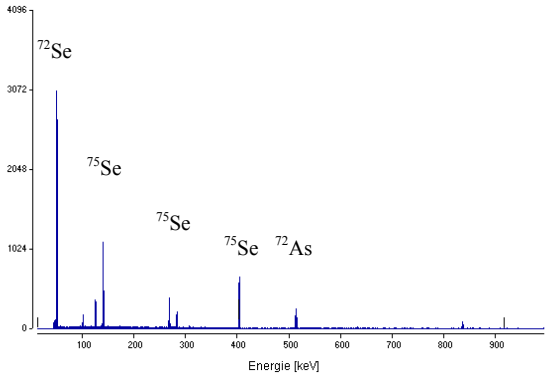

Fig.1: γ-spectrum of the $^{72}Se/^{72}As$ isotope generator before elution (characteristic emissions of ^{75}Se, side-product of cyclotron production of ^{72}Se, are also observed)

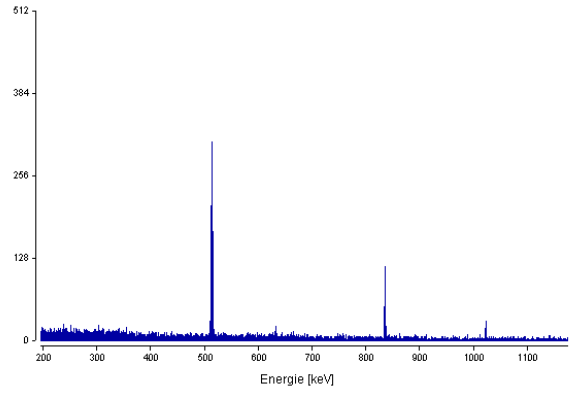

Fig.2: γ-spectrum of nca ^{72}As after elution, characteristic γ-lines: 511 keV (176 %), 834 keV (80 %), 1023 keV (Sum-Peak)

References:

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