Reliability of results on the determination of ^{232}Th in urine by IAAN

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Abstract

The first purpose of the Laboratorio de Radiotoxicologia (LRT) is support the internal dose evaluation with significant and reliable bioassay results. A simplified procedure to determinate the ^{232}Th in submicrogram amounts in the urine is very important for attempt this purpose. An AAN with post-irradiation radiochemical separation of the ^{233}Pa procedure (AANR) has used at IPEN with detection limits (MDA) around 4.00E-05Bq/L (1.00E-11g ^{232}Th/L), but it involves an extensive sequence of steps with an activated matrix. Besides the time spent in these routine and the common incidents of contamination of fume hoods, the reliability of the results was affected by the impossibility of measurement of the thorium recovery for each sample. The Instrumental Neutron Activation Analysis (INAA) is a simpler procedure. To validate the AANI to determinate ^{232}Th in urine, a study of the yield for each part of the radiochemical separation was carried out. A weekly urine pool collection of one same individual never exposed to occupational intakes of thorium was spiked with a gamma tracer of ^{234}Th. Four aliquots from the spiked pool was analyzed and the tracer recovery measured by gamma spectrometry. Another group of 10 samples from workers occupationally exposed were analyzed without the post-irradiation radiochemical processing to observe the co-activated matrix interference in the peaks resolution of the ^{233}Pa, in three different post-irradiation decay times: 7, 25 and 40 days. The results show that about 24% of the thorium can be lost before the activation and another 35% in the post-irradiation steps. The measurement of neutron activated samples after 25 days provided a good discrimination of the ^{233}Pa peaks. Considering historical dates from individuals monitored by the LRT during the last 7 years, whose the average amounts of ^{232}Th in urine are around 5.00E-04 Bq/L (1.20E-08 g ^{232}Th/L), the loss of an order of magnitude in the MDA and the improvement of 35% in the chemical yield allow the measurement of the same levels of intakes employing the simpler method.

KEYWORDS: Neutron activation analysis; ^{232}Th; Radionuclide bioassay; Matrix interference.