Possible renal failure associated with uranium toxicological and incorporation effects in animals

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Toxicological studies show that most of the uranium absorbed by the ingestion in the human system is retained in different body organs and then is excreted, partially, through urine. The amounts of the non-excreted uranium accumulated in these organs, particularly in the kidneys, could cause lesions. This paper reports the application of the neutron activation analysis (NAA) to determine the concentration of elements present in the biological urine samples from dogs doped with natural uranium. These results make possible to obtain the maximum of information for a detailed study of kidney malfunction.

For this investigation, urine samples of Beagles were used. These animals were chosen because 90% of their physiological characteristics are similar to those in humans [1]. The experiments were performed at the facilities of the UNITOX laboratory from the Universidade Santo Amaro (UNISA). Four male Beagles dogs were housed in individual bails at controlled room temperature. They were fed daily with dog chow doped with uranyl nitrate at a concentration of 100 ppm, except the control animal. This procedure was performed during 5 months: the uranium ingestion started after weaning (~60 days) and continued in the animal maturity. After the 5 Th month. In the end of the experiment these animals were sacrificed.

During all the experiment the following procedure has been carried out: daily control and measurements of the ingested food; daily control and measurements of the animal weight and collect of biological material (urine, feces and blood).

For these analyses a HPGe detector connected to a multichannel analyser and to a PC computer was used to measure the induced gammma-ray activity. This procedure was made to identify and quantify the radioactive nuclides ^{38}Cl ($T_{1/2}$=37.29 min, Eγ =1642.0 keV), ^{42}K ($T_{1/2}$=12.52h, Eγ =1524.70 keV), ^{24}Na ($T_{1/2}$=15h, Eγ =1368.4 keV). To determine the concentration of the elements CL, K and Na, in the urine sample, aliquots of 100 μl of the sample were pipetted onto 1cm^2 pieces of Whatman N° 40 filter paper, that were sealed in polyethylene bags. As standards, convenient aliquots of standard solutions of Na, Cl, and K were prepared in a similar way as the samples. Samples and standards were irradiated for 15 minute in the IEA – R1m reactor of IPEN/SP, in a thermal neutron flux of 10^{13} n/cm^{2}s. After irradiation, the sample and standard were gamma-counted for 10 minutes and the area of the select gamma-ray peaks were obtained by using the VISPECT program [2]. The concentration of the elements was obtained using the comparative neutron activation analysis.

Biochemical tests in urine were also performed in order to determine the concentration of creatine and urea, related to the uranium ingestion. The results of the nuclear analysis were correlated with the biochemical tests, but it was not possible to identify any renal failure associated with uranium toxicological effects in the animals doped with uranyl nitrate at a concentration of 100 ppm.

References

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