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Application of INAA for measurements of prostatic tissue levels of chemical elements used as cancer markers

Vladimir Zaichick
Medical Radiological Research Center, Russia

Prostate cancer is an internationally important health problem of the man, particularly in developed countries. The aim of this exploratory study was to evaluate whether significant changes in the prostatic tissue levels of chemical elements exist in the malignantly transformed prostate. Prostatic tissue levels of Ag, Br, Ca, Co, Cr, Fe, Hg, K, Mg, Mn, Na, Rb, Sb, Sc, Se, and Zn contents were prospectively evaluated in 32 patients with benign prostatic hyperplasia (BPH) and 36 patients with prostate cancer. Intact prostates of 37 men who had died suddenly were used as the age-matched control group. Measurements were performed using non-destructive instrumental neutron activation analysis (INAA) with high resolution spectrometry of short- and long-lived radionuclides. Prostate tissue samples were divided into two portions. One was used for morphological study while the other was intended for chemical element analysis. It was found that the contents of Al, Br, Cr, Fe, Hg, Mn, Sb were significantly higher while those of Ca, Co, K, Mg, Na, Rb, Sc, Se, and Zn were significantly lower in cancerous tissues than in BPH and normal tissues. Moreover, it was shown that the chemical elements mass fractions in prostate tissue, their ratios and other combinations are very informative markers of prostate cancer.

vezai@obninsk.com

Experimental results on cross section for ^{7}Be photo-production on ^{12}C, ^{14}N and ^{16}O nuclei

V S Malyshevsky
Southern Federal University, Russia

At present, the monitoring of radionuclides content in the air-ground interface suggests the conclusion that the radioactivity of ground air is essentially contributed by a short-lived isotope ^{7}Be of cosmic origin. The ^{7}Be isotope presents interest not only from the standpoint of its radioactive effect on biological systems, but also because it can serve as an indicator of the build-up of air-supplied pollutants by natural environments. The last-mentioned property may be conveniently used for estimating a possible atmospheric pollution and air ex-change in the environment. Therefore, the investigation into the mechanisms and regularities of the processes of ^{7}Be generation, transport and migration in the ecosphere objects and at their interfaces appears rather urgent. It is considered that the main reactions leading to beryllium isotope generation in the terrestrial atmosphere take place at interaction of cosmic rays with nitrogen and oxygen nuclei, which are the principal constituents of the atmospheric air. Another possible mechanism of ^{7}Be generation in the upper atmosphere may lie in photonuclear reactions. The results that we obtained amount to the following. The yields of the A(γ,X)^{7}Be reactions on ^{12}C, ^{14}N, and ^{16}Onuclei have been measured in the energy range of 40–90 MeV. The cross sections for the A(γ,X)^{7}Be reactions on ^{12}C, ^{14}N, and ^{16}O nuclei have been calculated by using the measured yields and the calculated bremsstrahlung spectrum. The experimental cross sections for photonuclear reactions leading to ^{7}Be production have been compared with their counterparts obtained with the aid of the TALYS 1.4 package. The cross sections for the photo-production of the isotope ^{7}Be on 14Nand ^{16}O nuclei have been obtained for the first time. Agreement between the results of the measurements and calculations for ^{12}C and ^{14}N nuclei at energies above 50 MeV has been proven.

vsmalyshevsky@sfedu.ru