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Transferência de Urânio em vegetais

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A motivação para este trabalho está no fato de termos uma taxa de mutação consideravelmente alta em plantações de tomates, aproximadamente uma a cada 3000 plantas, sendo esta taxa de uma a cada 10000 em outros vegetais. O tomateiro é uma planta ávida por fósforo e a presença do urânio em jazidas de fósforo é muito comum no Brasil.

Arruda et all [1] estudaram a presença de uranio em rações animais encontrando concentrações que variavam de 3 a 200 ppm. A Organização Mundial da Saúde recomenda uma presença máxima de 30 ppm.

Cultivamos em sistema hidroponico 20 plantas distribuídas em 4 cubas. As cubas foram contaminadas com 5, 20 e 60 ppm de nitrato de uranila cada, e uma foi utilizada como controle. O experimento durou 94 dias, a cada semana retiramos amostras de folha, raiz, flor e fruto. Amostras de caule eram retiradas a cada duas semanas e uma planta era sacrificada. As soluções de nutrientes foram trocadas no 45^0 dia de experimento. No 80^0 dia retiramos o nutriente, lavamos todas as cubas com ácido nítrico e colocamos soluções não contaminadas. O objetivo é estudar a absorção e possíveis translocamentos de urânio no vegetal. As amostras foram pesadas com uma balança analítica, incineradas e suas cinzas dissolvidas separadamente em ácido nítrico concentrado. Após dissolução a solução é colocada em um bequer para evaporação, seu resíduo é dissolvido em ácido nítrico 2% completando um volume de 10 ml para todas as amostras. Colocamos frações da solução em folhas(detetores) de Makrofol E. Os detetores com a solução são colocados sob uma lampada de infra vermelho para a evaporação da fase líquida. Com outro detetor, formamos um sanduíche com a amostra. Vários sanduíches são colocados em um cilindro de alumínio que é devidamente lacrado. Também estamos ulizando folhas de Makrofol KG. Este detetor nos permite usar um contador automático para realizar as leituras.

Os cilindros estão sendo irradiados com fluxos de neutrons do reator IEA-R1, 5MW do IPEN (Instituto de Pesquisa Energéticas e Nucleares).

Usaremos uma solução de hidróxido de potássio para fazer a revelação dos traços de fissão nos detetores. Realizada a comparação com uma amostra padrão, determinaremos a quantidade de urânio presente nas amostras biológicas.

Referências:

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DETERMINATION OF TRACE ELEMENTS IN WISTAR RATS BONE BY NEUTRON ACTIVATION ANALYSIS

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The present study is part of the project: "Study of uranium biodistribution in the food chain", with the aim of investigating the uranium transfer from soil to the human beings. Particularly in this experiment, the main idea is to investigate physiological alterations induced by intake of natural uranium in Wistar rats bone.

The Wistar rats have been selected as a convenient animals for this study in function of the cost, handling and medico- legal implications. The experiment was performed with 15 male rats, 15 days old, assembled in groups with 2 animals each, and a control group with 3 animals. During two months they were kept in a temperature and air-controlled room and they were fed daily with chow doped with uranyl nitrate (except for the control group), at the following ppm concentrations of uranium per group: 20, 50 and 100. The control and measurements of the amount of ingested food and animal weight were carried out daily during the experiment. After that the animals were sacrificed and dissected.

The samples of bones were calcinated, ground and homogenized and the ashes were analyzed by neutron activation analysis (NAA).

Basically, the bone consists of 45 % of water, 35% mineral salts (chiefly calcium and phosphorus) and 20 % organic matter (chiefly collagen). Particularly, the inorganic fraction also contain small amounts of Sodium . Magnesium, Potassium and other trace elements. The procedure to identify and to determine the concentrations of these elements was the following: 50 mg of the ashsed samples were weighed and sealed in polyethylene bags; aliquots of standard solutions the elements of interest, were pipetted onto 1 cm^2 pieces of Whatman No.40 filter paper, evaporated to dryness under an infrared lamp and were also sealed into polyethylene bags; samples and standards were irradiated at the IEA-R1m nuclear reactor of IPEN/CNEN-SP. In order to determine short half live isotopes, the samples were irradiated at a thermal neutron flux of $5.10^{12}n/\ cm^2.s$ for 3 minutes, and at a flux of $10^{12}n/cm^2.s$, for 8 hours, to determine long half live isotopes. For uranium analysis, samples and standard were irradiated inside a Cadmium capsule.

The samples and standard were analyzed with a gamma-spectrometer with Ge detector of high resolution (FWHM<1.87 keV at 1.32 MeV of ^{60}Co), mounted inside a lead shield hood in order to reduce the background radiation. The detector was operated with 671 ORTEC amplifier, in pile-up rejection mode. For Phosphors determinations, the beta particles of ^{32}P were measured by using a Geiger Muller detector.

The concentration of the Al, As, Ca, Cl, Mg, Fe, K, Na, Rb, Sr, Zn and U for 20, 50 and 100 ppm, were determined and the results were discussed according to the uranium ingestion.

Since bone is a major component of the skeletal system and about 99% of body calcium is found in side it we could compare the evaluation of Ca in the control group (normal value) with those group doped with uranyl nitrate.

According to the results obtained no significant differences were observed among the values, especially for Ca and P, though an accumulation of Uranium in the bone was verified.

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Charged Photoparticle Production During High Energy Radiotherapy

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In the present work a Monte Carlo calculation is used to estimate the relative contribution to total dose imparted within the tissue due to charged particles produced by high energy bremsstrahlung beams during radiotherapy. The photonuclear reactions are interpreted in the basis of a two-step model in which the incoming photon is assumed firstly being absorbed by the nucleus, so that its incident energy is shared among the nucleons thus initiating an intranuclear cascade. In a second stage, after thermodynamic equilibrium was reached, a mechanism of evaporation predominates, where nucleons and alpha particles are emitted by the residual nucleus. The total photoparticle yields are, therefore, obtained by considering these two referred stages and taking in account the tissue composition, $C_5H_{40}O_{18}N$ [1]. For radiation treatments with photon beams in the energy range 3-30 MeV the photonuclear reaction fast step is treated semi-empirically, based on Monte Carlo method. The calculation of protons and neutrons production in tissue is thus grounded on the semi-classical dynamical evolution of the ensemble of nucleons plus the incident photon [2]. Photon energies are obtained according to a bremsstrahlung spectrum with maximum energy E_0. The ground state initial configuration is established by assuming to each nucleon of the target nucleus a momentum so as to reproduce the Fermi free gas distribution. After the primary photonuclear reaction we proceed a total momentum-energy distribution for the whole system, preserving strictly the total four-momentum conservation. The intranuclear cascade thus starts by taking into account elastic and particle production processes among the nucleons of the system. Besides scattering process we regard also some quantum effects typical of the energy range under consideration. Hence, the nuclear interaction is simulated in terms of a fictitious nuclear surface from where nucleons can pass through, leading to an emitted particles multiplicity. These emitted particles are those who will impart the extra dose to the tumor and peripherical tissue. At the end of the fast step, after thermodynamic equilibrium was reached, the excited nucleus starts slowly to emit particles, as a result of a mechanism of competition among evaporation of neutrons, protons, and alpha particles experienced by the residual nucleus. This process lasts until the complete de-excitation of the nucleus. This slow phase, henceforth named evaporation phase of the reaction, is typically treated according to the statistical model proposed by Weisskopf [3] and Vandenbosch and Huizenga [4]. Then, we will follow the literature taking the average residual nucleus mass and atomic numbers, and excitation energy as in input to the slow step of reaction. The combined