Polycarbonate Chromatography Column to Be Used in a ^{99}Mo/^{99m}Tc Generator Irradiated in Saline Solution with EB and γ-Rays

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The technetium-99m generator (technetium cow or moly cow) is a device used to extract the metastable technetium isotope ^{99m}Tc from a source of decaying molybdenum-99. ^{99}Mo has a half-life of 66 hours and can be easily transported over long distances to hospitals whereas its ^{99m}Tc decay product (half-life of 6 h is inconvenient for transport) is extracted and used for several nuclear medicine diagnostic procedures, where its short half-life is well adapted. This device works as a closed system, where the principal component is a chromatographic column of acid alumina (Al_2O_3) as stationary phase. Currently this column is produced using borosilicate type 1 glass.

The goal of this study was to characterize the irradiated polycarbonate (PC) column in saline solution to simulate a ^{99}Mo/^{99m}Tc generator in real use conditions. PC column and PC samples were EB and γ-irradiated in saline solution with radiation absorbed doses up to 200 kGy. Samples were analyzed by electron paramagnetic resonance spectroscopy (EPR), infrared spectroscopy (FTIR), ultraviolet spectroscopy (UV), differential scanning calorimetry (DSC) and wide-angle X-ray diffraction (WAXD). Additionally, the γ-irradiated PC column in presence of saline solution was studied using high performance liquid chromatography (HPLC) coupled with fluorescence detection in order to investigate the chemical phase diffusion of bisphenol A (BPA). EPR results showed at X band region a strong singlet attributed to a phenoxyl radical in the irradiated sample at room temperature. Decay of radical occurs approximately within 40 days. UV spectra presented increase in relative absorbance at 400–450 nm with increasing radiation dose. Ionizing radiation caused greenness of the original clear PC samples. This discolouration confirms the formation of phenoxyl radicals. On the other hand, glass transition temperature decreased by 1% (5K) for the maximum radiation applied dose. Similarly, a small decrease on carboxyl group peak at 1770 cm^{-1} was observed by FTIR. No detectable change on crystallinity was observed by WAXD. For sterilization absorbed dose, results shown no significant changes on the studied properties that way can be recommend to use PC columns instead borosilicate glass column in the ^{99m}Tc generator. The protocol via HPLC with fluorescence detection used in this work can be employed to detect the chemical phase diffusion of BPA in saline solution at ppb concentration