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Structural and retrospective bio-dosimetric study of gamma-irradiated human fingernails

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Abstract

Emergency involving ionising radiation is a rare occurrence, yet it can leave severe damage if a population is not equipped with necessary preparation. In such a situation, there is no viable way to know how much radiation dose is received by human beings. However, in present time only personnel of rescue teams have accessed to active dosimetry such as a personal dosimeter. Preliminary study has been made of human fingernails, a model in examining the potential of nails of the human fingers in retrospective and emergency bio-dosimetry applications, also offering effective atomic number near to that of soft human tissues at 7.4. Human fingernails were sampled from different age groups and exposed to ⁶⁰Co gamma rays, delivering doses from 2 to 10 Gy. Structural alterations were observed, use being made of Raman spectroscopy and the crystalline structure of alpha keratin is studied using X-ray diffraction (XRD), while the elemental composition of the sample is determined by energy dispersive x-ray (EDX) analysis. Raman shows the 'fingerprint' of nail sample is identical in which the peak assignment concerns on the disulfide (S-S) bond and the alpha helix content at the amide 1 region. These are the few regions which displayed major Raman shift and intensity difference from a normal nail sample and an effected nail which have the same analogy as a non-irradiated nail and an irradiated nail sample. XRD shows the molecular structure of hard α -keratin from different age groups of fingernails, examining crystallite diameters (D) and crystallinity index (C.I.). The α -keratin characteristic bands can be seen in all groups of fingernails, albeit they become much weaker and shift to smaller angles with higher gamma doses. The results obtained by Raman spectroscopy and X-ray diffraction are complementary and suggest that the α -helix structure of keratin is partially destroyed by the presence of radiation. © 2024 Elsevier Ltd

Author Keywords

Biodosimetry; Fingernails; Gamma irradiation; Raman spectroscopy; X-ray diffraction

Index Keywords

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