The influence of gamma rays on the molecular bone structure. A Synchrotron FT-IR study

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Infrared Fourier Transform (FT-IR) spectroscopy is widely used in the last two decades to characterize the molecular structure of bones. On the other hand, in bone cancers the irradiation with ionised radiation is the most common method of cancer treatment or the reduction of the bone pain. In this work FT-IR spectroscopy was used to investigate the influence of gamma rays (γ-^{60}Co) on human bones. The samples were taken from 30 patients who went under a surgery for various reasons. From the study were excluded patients who had bone cancer. The bone samples, after treatment with hydrogen peroxide and acetone to remove the blood and fat of the bones, were irradiated with 59.22, 98.7, 197.4 and 592.2 Gy. Comparison of the FT-IR spectra before and after irradiation showed changes depending on the dose of irradiation.
From the new band at 1672 cm^{-1}, which is attributed to primary amines with aliphatic chain with less than ten carbon atoms, it was concluded that the chain of proteins are broken from the free radicals that are produced upon irradiation. It was also observed that the irradiation of collagen changed from alpha helix to random coil. In addition, the calcium carbonate ($CaCO_3$) changed from calcite to another crystal system. Changes were also observed in the region 900-1020 cm^{-1}, where the phosphate (PO_4^{3-}) absorbs. These changes seem to be due to crystal effects in the bones and degree of crystallinity. It is also important to note that there were no changes in the spectra after irradiation, if the bones were irradiated after treatment with DMSO. In this case the spectra remained unchanged until a dose of up to 592.2 Gy.