FTIR Spectroscopy and Imaging in Ionizing Radiation and Radiation Protection Monitoring: Application to Biomedical and Food Sciences

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Fourier transform infrared (FTIR) spectroscopy/microscopy together with chemometric tools are successfully and widely used to monitor disease, chemical or environmentally-induced structural and functional changes in the molecules of biological systems. However, application of these techniques on radiation science is very limited. This technique can be used to differentiate irradiated and non-irradiated tissues, to monitor radiation-induced damages and to study the protective effect of some chemicals. Here, as a biomedical application, the restoring effect of amifostine on ionizing radiation-induced damages and the sole effects of amifostine on lipids and proteins of healthy rat liver microsomal membranes and brain tissues are reported. Amifostine (WR-2721) is the only approved radioprotective agent by the Food and Drug Administration (FDA). The results revealed that radiation induces significant alterations in the concentration, composition, structure and function of lipids in the liver microsomal membranes [1] and white matter (WM) and grey matter (GM) regions of brain tissues [2] and amifostine restores radiation-induced damages in these systems. Artificial neural network (NN) results showed that radiation also caused significant changes in the secondary structure of proteins by inducing an increase in the turn and random coil structures which are restored by amifostine treatment [1,2]. Based on these spectral differences, irradiated samples were successfully differentiated from the control samples. However no significant changes were observed in healthy systems in terms of molecular concentration, lipid structure and protein secondary structure due to amifostine treatment, which may indicate that amifostine is non-toxic for the biological systems and can be successfully used as a radioprotectant agent in radiotherapy. As an application from food sciences, the differentiation of un-treated and low and high dose ionizing radiation-treated hazelnut tissues based on infrared spectral differences is given. It was shown that irradiated samples were successfully differentiated from non-irradiated food samples using cluster analysis and principal component analysis (PCA) methods.

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