Characterization of Gamma-Irradiation Damages on the Molecular Structure of Adipose Tissue using Raman Spectroscopy

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Elucidation of irradiation damages to the structure of lipids is important to both cellular radiobiology and food irradiation fields. Lipid peroxidation is a major damaging process in membranes and liposomal dispersions and is responsible for the impairment of enzyme activities, chemically-induced toxicity and damages to DNA. Treatment of fats with ionizing radiation is believed to accelerate lipid oxidation via the action of various unstable free radicals

Being non-destructive and having a high sensitivity towards the molecular composition and conformation of biomolecules, Raman spectroscopy was chosen to be the analytical tool to characterize irradiation-induced changes in the chemical composition of adipose tissues. Adipose tissue is a connective tissue that functions as the major storage site for fat in the form of triglycerides.

We have investigated 1 kGy to 10 kGy gamma irradiation damages on the molecular structure of lamb, beef and porcine adipose tissues using Fourier transform Raman spectroscopy. Gamma irradiation-induced changes on the saturation level of fatty acids and the extent of lipid peroxidation were monitored by screening the C=C and C=O stretch related Raman scattering modes. The most irradiation sensitive vibrational modes was found to be the C-H stretch modes detected at 1302 cm^{-1} and 2800-3000 cm^{-1} region of Raman spectrum, probably due to the abstraction of hydrogen atoms from the aliphatic tail groups by the attack of free radicals. These irradiation perturbed Raman data was treated with a chemometric model known as canonical variate analysis to differentiate adipose tissues based on the extent of irradiation.

This presentation covers the radiochemistry of lipids and characterization of radiochemical changes upon irradiation at the molecular level. The potential of Raman spectroscopy along with a proper multivariate qualitative analysis method to discriminate adipose tissues with respect to the applied dose will be demonstrated.