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Molecular Insights on Iodine Incorporation-based Photoactivation Therapy

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The EU Commission estimates that 31% of men and 25% of women in EU member states will be diagnosed with cancer before the age of 75. This underscores the need to improve cancer therapies for better patient outcomes.

The project investigates the effects of iodine substitution in DNA for radiotherapy. Thymine is substituted with Iodine to form iodinated uracil which is then incorporated into site-specific DNA strands of varying lengths and oligonucleotide compositions. These modified DNA strands are exposed to X-rays tuned to the iodine 2p threshold, enabling localized and locally increased radiation damage. This makes iodine act as a radiosensitizer. We compare the fragmentation process of DNA with and without this radiosensitizer and investigate how iodine substitution, DNA length, and base composition influence the resulting fragmentation patterns, pathways and fragment yields.

Our methods consist of simulating the radiation-induced fragmentation process using a combination of Density Functional Theory and Molecular Dynamics. Complementary experiments at Synchrotrons are conducted. By integrating simulation and experimental results, we aim to provide a comprehensive understanding of the molecular mechanisms behind radiation-induced damage in Iodine substituted DNA, contributing to the development of more effective radiotherapies and improved radiation protection strategies.