Low Energy Electron Interaction with Duplex Supercoiled and Relaxed, and Single Stranded Plasmid DNA

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The energy transfer from ionizing radiation to molecules generates large quantities (~10^5/MeV) of low energy electrons (LEE, <30 eV). It is surmised that such copiously produced LEE mediate strand breakages in DNA. In order to get insights that are biologically relevant, we have analyzed strand breakages in supercoiled and relaxed plasmid duplex DNA and compared the same with single stranded circular DNA plasmid forms. Efficient conversion to relaxed form of DNA from highly purified supercoiled plasmid DNA preparations was generated by the action of *Drosophila* Topoisomerase-I. Most studies in this field so far have focused on only supercoiled plasmid [1] and to the best of our knowledge, none on other forms of DNA. Therefore, our studies in the electron energy range 10 to 25 eV report first-time observations along these lines. The results indicate that LEE induces strand breakages on both supercoiled as well as relaxed duplex plasmid DNA. The efficiencies were comparable in both cases. Unraveling strand nicks in the latter involved gel analyses of DNA following duplex denaturation by alkali treatment. We uncovered discernible strand breakage products from relaxed form of DNA only following duplex denaturation, thereby revealing single strand nicks being generated by LEE. Therefore, supercoiling energy was not mandatory for imparting strand breakages. Most surprisingly, the same conditions of LEE exposure yielded no strand nicks in single-stranded plasmid DNA. It is pertinent to point out that LEE interaction with ssDNA [2] shows larger electron capture compared to double stranded DNA. Hence, it is necessary to distinguish between electron capture and strand breaks when considering LEE induced damage to DNA and obviously necessitates detailed experiments need to be performed to unravel these aspects of LEE interaction. We believe that any strand breakage model on LEE – DNA interactions must involve DNA double helix chemistry; although several previous studies have revealed neutral and ionic desorptions [*e.g.* Ref. 3] resulting from dissociative electron attachment / dissociative ionization steps and intrinsic hydration water in layered DNA samples consisting of either single (Oligos) or double stranded DNA on solid surfaces.

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