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Radiation Chemical Studies Leading to the Development of Selenium Radioprotectors

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Radiation chemistry, a discipline involving study of chemical changes induced by ionising radiation, has been the subject of interest for both researchers and technologists. Extensive research carried over the last few decades has translated into applications in the areas of advanced materials, nuclear fuel cycle, radiotherapy, sterilisation, waste treatment, water purification etc. Radiation chemistry of water as one of the important areas of research, provided understanding of the primary processes of water radiolysis, the same has also led to the progress of another related field, radiation biology. Hydroxyl (•OH) radical, a powerful oxidant generated during water radiolysis triggers sequence of events in the living cells causing several changes including mutations in DNA and cell death. While this formed the basis of radiotherapy for cancer treatment, the same became a matter of concern due to unwanted normal tissue radiation damage. In order to minimise this unwanted radiation damage to the normal tissue, radioprotectors are employed. Search for radioprotectors began from Second World War and after screening several thousands of natural and synthetic sulphur compounds, only one compound, amino thiol known as, "amifostine"has been approved in the clinic. Our recent experience in the research area of radiation chemistry of selenium compounds, prompted us to find a new direction of developing radioprotectors from organoselenium compounds. Selenium as a member of chalcogen group shares similarities with sulphur and is a micronutrient and a constituent of redox active selenoenzymes like glutathione peroxidise. A number of selenium compounds such as selenoethers, diselenides, monoselenides have been synthesised and screened for radioprotection. Since •OH radical reaction is the primary process in radiation damage, the reactions of selenium compounds with •OH radical were studied in real time scales. For these studies, pulse radiolysis, a time resolved linear electron accelerator based technique, used to follow chemical reactions in nanoseconds, was employed. The results indicated that in these compounds, selenium is the active centre for the attack of •OH radical and the reaction leads to formation of selenium centred radical cation, which interacts with the nearby hetero atoms through non-bonding interactions. Depending on the strength of interactions, the radical actions are converted to oxidised products, which played a crucial role in deciding whether the selenium compound can be explored as a radioprotector or not. Similar studies on several substituted selenocarboxylic acid derivatives suggested that a diselenide having propinoic acid substitution is structurally best suited for developing as radioprotector. Accordingly diselenodipropionic acid examined in vivo systems was found to be a good organ specific radioprotector. Some of these results will be presented in the lecture.

Country/Organization invited to participate

India

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