LECTURE ABSTRACT

Naturally Occurring Terrestrial Radionuclides: Root Uptake, Soil-Plant Transfer and Radiological Risk Assessment

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Abstract

Naturally occurring radionuclides (NORM), principally ^{238}U (^{226}Ra), ^{232}Th (^{228}Ra), and ^{40}K, are ubiquitous in terrestrial environments and represent the dominant source of human radiation exposure globally. This lecture provides a comprehensive, quantitative introduction to their primordial origins, complete radioactive decay series, and the concept of secular equilibrium, with particular emphasis on how disruption of equilibrium affects environmental measurement. The soil-plant transfer pathway is examined as the principal route for internal human exposure via food ingestion, introducing the Transfer Factor (TF) and the physicochemical soil properties, pH, organic matter, cation exchange capacity, clay mineralogy and competing ions that govern radionuclide bioavailability. Drawing on empirical data from Nigeria, South Africa, Vietnam and Italy, students learn why tropical agroecosystems exhibit markedly higher TF values than temperate counterparts. A five-step radiological risk assessment methodology is then developed step by step: calculating external absorbed dose rates from soil gamma activity concentrations using UNSCEAR conversion factors, deriving annual effective doses through occupancy factors, estimating internal ingestion doses via ICRP dose coefficients, and computing the incremental lifetime cancer risk (ILCR) against USEPA and ICRP regulatory thresholds. Worked examples and graded exercises reinforce each calculation stage, equipping learners with a transferable quantitative toolkit applicable to any NORM-impacted agricultural site.

Keywords: NORM · Transfer Factor · Secular equilibrium · Annual effective dose · Incremental lifetime cancer risk · Soil-plant pathway