

Estimation of Radon (^{222}Rn) activity concentration levels and associated effective dose in bottled drinking water from South Africa

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The naturally occurring radioactive gas Radon-222 (^{222}Rn), poses potential health risks due to its inhalation and ingestion, especially through drinking water. This paper presents the investigation of the activity concentration levels of ^{222}Rn in 21 brands of bottled water samples collected from the open market in South Africa. The samples were analysed using a highly sensitive system consisting of the Ionization Chamber AlphaGUARD (PQ 2000), an AquaKIT set, and an AlphaPUMP, ensuring precise measurement of radon activity. The results revealed significant variations in radon concentrations across different brands, with values ranging from $0.062 \pm 0.046 \text{ Bq/m}^3$ to $0.198 \pm 0.286 \text{ Bq/m}^3$, with a mean of $0.118 \pm 0.034 \text{ Bq/m}^3$. These measurements were then used to estimate the annual effective ingestion dose of radiation for consumers across various age groups, based on the guidelines provided by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). The mean effective doses were found to be $4.057 \times 10^{-4} \pm 1.188 \times 10^{-4} \text{ mSv/y}$ for infants (1–2 years), $2.428 \times 10^{-4} \pm 7.111 \times 10^{-5} \text{ mSv/y}$ for children (7–12 years), and $2.058 \times 10^{-4} \pm 6.026 \times 10^{-5} \text{ mSv/y}$ for adults, all of which are below the recommended international safety limits and are comparable to other published studies. These findings suggest that the bottled drinking water in South Africa is safe for consumption and does not pose a significant health hazard from ^{222}Rn radiation. The study underscores the importance of monitoring radon levels in bottled water to assess the associated radiological health risks, particularly in South Africa, where access to safe drinking water is essential. This research provides baseline data for future regulatory frameworks and policy development and can serve as a valuable reference for bottled water producers. Furthermore, it highlights the need for continued investigation into the regulation and mitigation of radon exposure in drinking water sources throughout the country.

Keywords: Radon-222, activity concentration levels, annual effective ingestion dose, bottled drinking water, South Africa