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Levels of natural radionuclides in some Nigerian cereals and tubers

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Abstract

The activities of radionuclides in the two major groups of foodstuff widely consumed in Nigeria have been determined. The ^{40}K concentration range from 9.9 ± 3.6 Bq kg^{-1} to 298 ± 14 Bq kg^{-1} (av. 130 ± 8.12 Bq kg^{-1}). ^{238}U concentration range from 1.47 ± 0.91 Bq kg^{-1} to 39.5 ± 9.9 Bq kg^{-1} (av. 11.5 ± 3.86 Bq kg^{-1}), and ^{232}Th range from 3.50 ± 1.85 Bq kg^{-1} to 10.5 ± 2.13 Bq kg^{-1} (av. 6.78 ± 2.13 Bq kg^{-1}). ^{137}Cs was not detected in any of the foodstuffs analysed.

Keywords: Radionuclide; Foodstuffs; Activity; Gamma-ray; Ingestion

1. Introduction

The deleterious radiological health hazards posed by human activities, especially in the production of energy, research and medical applications of nuclear facilities have attracted great concern and tremendous interest over the years in the field of

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radiation protection. Dietary pathways become contaminated with radioactive materials from these man-made applications during routine operation, accidents, and migration of radionuclides from radioactive waste disposal repositories into the biosphere. This anthropogenical contribution gained prominence after the Chernobyl nuclear power plant accident on 26 April 1986 when large quantities of radioactive substances were released to the environment, which eventually found their way in the soil and vegetation (Tang et al., 2003; Rahman and Voigt, 2004). One of the major anthropogenic sources of contamination in the environment is radiocaesium (^{137}Cs, half-life 30.2 years), as reported by many authors (Rahman and Voigt, 2004; Velasco et al., 2004). It is a dominant fission product with high relative mobility in the soil–plant system, long term bioavailability, high radiotoxicity and is long lived. Apart from these man-made sources, the radiation burden of the environment is constantly being enhanced by ionizing radiations from natural sources and their transfer to plant have been noted by many authors (Velasco et al., 2004; Badran et al., 2003).

Contamination of the food chain occurs as a result of direct deposition of these radionuclides on plant leaves, root uptake from contaminated soil or water, and animals ingesting contaminated plants, soil or water. Considerable efforts are being made by many authors in many parts of the world to measure the activity of radionuclide in the food chain and the estimated soil–plant transfer of radionuclides (Velasco et al., 2004; Carini, 2001).

In view of the potentially dangerous effects of radioactive substances, no effort should be spared in their qualitative and quantitative determination in all the identifiable pathways. In Nigeria, for example, radiation data needed for setting radiation limits are limited (e.g. Olomo, 1990; Olomo et al., 1994; Arogunjo, 2003; Arogunjo et al., 2004) when compared with other parts of the globe, despite various nuclear research applications of radioactive sources in many parts of the country. A research reactor is currently being built at the Centre for Energy Research and Training (CERT) in Zaria in the northern part of the country and a Tandem linear accelerator is already operational at the Centre for Energy Research and Development (CERD) at Ile-Ife in southwestern Nigeria. In a potentially high radiation area, where nuclear facilities are operational, efforts should be made to determine the presence of radionuclides in all pathways in order to ascertain the pre-nuclear facility operational level in order to provide baseline data to assess transfer into the food chain.

Cereals and starchy tubers are the main staple foods in Nigeria; therefore radionuclides in these foods are of radiological significance when assessing the contribution to the internal dose through the ingestion pathway. It has been noted that food processing can greatly reduce the radioactive content of final edible products; therefore neglecting the losses during food processing can lead to overestimation of the calculated dose (Carini, 1999). However, in an area where raw foods are the staple edible products, neglecting contributions from all pathways can lead to underestimation of the average food concentration. The present effort can provide a good opportunity to assess internal doses to the general Nigerian population.