

The Annual Effective Dose of Natural Radioactivity Intake from Animal Products Consumption in Phosphate Polluted Area

Abdelmonem AM*, El-Zohry M and El-Zayat MH

*Department of Physics, Faculty of Science and Arts, University of Jouf, Post Office 207, Al-Jouf, Kingdom of Saudi Arabia

Abstract

Due to the close correlation between environmental radiation protection and human health protection, the normal radiological activity of ^{226}Ra , ^{232}Th , and ^{40}K were measured in samples of beef and milk as animal products. The measurements were performed using a gamma spectrometer to measure those animal products collected from four different regions, namely Mahamid, Cap, Helal and Nesrab in Upper Egypt. The uptake of these radionuclides was estimated from animal food, clover, straw, and water. Results showed that the concentration of ^{226}Ra , ^{232}Th was lower than the permissible values. The total annual dose of natural radionuclides was estimated as a result of the consumption of the population in those areas contaminated with phosphates for animal products. The total effective annual dose of beef consumption was estimated as 1.868, 1.889, 1.644, 1.756 $\mu\text{Sv/yr}$ in the studied areas respectively. Since the concentration of radionuclides ^{226}Ra , ^{232}Th , ^{40}K in milk is higher than in beef, the total annual effective dose of milk consumption was higher than beef consumption. The effective annual dose was less than the annual permissible dose for the public. The obtained results indicate that a safe consumption of animal products in the area under investigation.

Human activities, the most important of which are the production of energy and military operations, such as nuclear activity tests or radiation leakage, are related to the presence of radionuclides in the environment. Studies have also shown the importance of studying the radiation activity of the consumable parts of animal products. Some mining industries such as phosphate, which causes the spread of phosphate dust in the environment, as well as industries related to the production of agricultural fertilizers, contribute to the generation of naturally radioactive materials in the environment surrounding these industries. Phosphate dust contains a large number of natural radionuclides from ^{238}U , ^{232}Th and ^{40}K . Phosphate dust is spread over large areas through wind and rainwater and is accumulated in soil and vegetation, which has a negative impact on human health.

The main pathways for the entry of natural radionuclides into the body are ingestion and inhalation according to Tawalbeh et al. Each radioactive radionuclide has a target, which is

concentrated in the human body, which affects negatively the human share, such as the weakness of the immune system and the emergence of many diseases and the consequent increase in mortality. Uranium toxicity primarily mainly affects kidneys. ^{232}Th causes its negative effect on the lungs, liver and structural tissues and ^{40}K in muscle tissue. The accumulation of large quantities of these radionuclides will affect the overall health of the human being and raise the rate of cancerous tumors causing death. Since Phosphate, mining causes a rise in the proportion of radionuclides in various agricultural activities around phosphate mining areas. Measuring the total dose in beef and milk is necessary to determine the effective dose that a person is exposed to as a result of his consumption because the persistence of radionuclides in the body is a function of its half-radiological and biological life. The risk to human health is linked to the long life of half of many radionuclides and carcinogens. The concentrations of ^{226}Ra , ^{232}Th and ^{40}K radionuclides were measured in animal foods. The uptake of these radionuclides was estimated in animal products.

The activity concentration of Radium-226, Thorium-232, and Potassium-40 were measured for an animal product in four different phosphate pollutant regions. These values below the recommended value by the international commission on radiological protection are the maximum annual dose to the public members. It is important to point out that these values are not the representative values for Egypt but for the regions from where the samples were collected. The total annual effective dose from milk ingestion is higher than the total annual effective dose from beef ingestion because a concentration of radionuclides (^{226}Ra , ^{232}Th , and ^{40}K) in milk are higher than those in meat. The concentration of ^{40}K radionuclides in animal food and an animal product is higher than the concentration of ^{226}Ra and ^{232}Th radionuclides. The values of Radium equivalent and external hazard index in Helal region is higher than the corresponding values of other regions, while the internal hazard index in Mahamid is higher than in other regions.

Keywords: Radioactivity; Concentration ratio; Animal products; Annual effective dose; Health risk