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*Research Paper*

# RADIOACTIVITY CONCENTRATION IN MILK CONSUMED IN NIGERIA

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Potassium-40 ($^{40}K$) is one of the most important natural radionuclides and is essential at very low concentration for the survival of all forms of life. This paper is aimed at sensitizing the populace of the possibility of high concentration of radionuclides in milk and it examines, the sources of milk consumed in Nigeria, the radioactivity pathways and also make recommendations that will ensure safety of our people.

***Keywords:*** Potassium-40, Radionuclides, Milk, Nigeria, Concentration

## INTRODUCTION

Milk is an important vector of radionuclides to man that may get into the environment from the mining activities. The radionuclides enter the human body mainly by two routes namely: inhalation and ingestion (Licata *et al.*, 2004).

The radioactivity measurements in environment and food stuffs are extremely important for controlling radiation levels to which mankind is directly or indirectly exposed. Besides natural radionuclides, due to several nuclear weapon tests and numerous nuclear reactor accidents, various artificial radioactive elements were introduced in the biosphere. Another important fact is that, importation of contaminated food from any region that suffered a nuclear accident, can indirectly affect people's health (Melquiades and Appoloni, 2004).

A great percentage of natural radiation exposure is due to ingestion of food containing natural radionuclide such as $^{40}K$, $^{226}Ra$, $^{21}Po$, $^{210}Pb$. Among these $^{40}K$ is the most important natural radionuclide in the environment from the health physics point of view.

The half life of $^{40}K$ is 1.3 billion years and it decays to $^{40}Ca$ by emitting a beta particles with no attendant gamma radiation (89% of the times) and the gas $^{40}Ar$ by electron capture with emission of an energetic gamma ray (11% of the times). So $^{40}K$ can present both external and internal health hazards. The strong gamma radiation (Ey = 1.46 MeV) makes the external exposure to this radioisotope a concern. While in the body 40 K poses a health hazard from the beta particles (FB Mav = 1.35 MeV) and gamma rays which associate with cell damage and

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general potential for subsequent cancer induction (Afshari *et al.*, 2009).

Among different kinds of foodstuffs, milk is a reliable indicator of the general population intake of certain radionuclides, since fresh milk is consumed by a large segment of the population, and contains several biologically significant radionuclides. So, the assessment of radioactivity levels in powdered milk is of crucial importance for controlling the radiation levels and necessary in establishing rules and regulations relating to radiation protection (Quindos *et al.*, 1994).

### Radioactive Contamination

Radioactive contamination also called radiological contamination is a radioactive substance on surfaces, or within solids, liquid or gases which their presence is unintended or undesirable, or the process giving rise to their presence in such places (IAEA, 2007). As with their contamination radioactive contamination refers only to the presence of the unintended or undesired radioactivity, and gives no indication of the magnitude of hazard involved.

### Sources of Contamination

Radioactive contamination is typically the result of a spill or accident during the production or use of radionuclides (radioisotopes), an unstable nucleus which has excessive energy. Less typically, nuclear fallout in the distribution of radioactive contamination by a nuclear explosion. The amount of radioactive material released in an accident is called the source term. Contamination may occur from radioactive gases, liquids, or particles. For example, if a radionuclide used in nuclear medicine is spilled (accidentally or through ignorance), the material could be spread by people as the walk around. Radioactive contamination may also be an inevitable result of certain processes, such as the release of radioactive Xenon in nuclear fuel reprocessing.

## CONTAMINATION PATHWAYS

Radioactive contamination can enter the body through ingestion, inhalation, absorption or injection. Radioactive contamination may also be ingested as the result of eating contaminated plants and animals or drinking contaminated water or milk from exposed animals.

Also, 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 anthrogenic contribution gained prominence after the Chernobyl nuclear power plant accident on 26$^{th}$ April 1986 when large quantities of the radioactive substances were released to the environment, which eventually found their way in the soil and vegetation (Tang *et al.*, 2003, Voight, 2004).

One of the major anthrogenic means of contamination in the environment is radiocaesium ($^{137}$Cs, half-life 30.2 years), as reported by some Authors (Rahman and Voight, 2004, Velasco *et al.*, 2004, Arogunjo *et al.*, 2005).

It is a dominant fission product with high relative mobility in the soil. Plant system, long-term bio availability, 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 and produce have been noted by some Authors (Velasco *et al.*, 2004, Badran *et al.*, 2003).

Contamination of the food chain occur as a result of direct deposition of these radionuclides on plants leaves, fruits, tubers, root uptake from contaminated soil or water, and animals ingesting contaminated plants, soil or water. Some works have been carried out in this area by some authors in recent time. The aquatic environment (like Niger Delta environment) received the greatest input of radionuclides from atmospheric testing of nuclear weapons and low levels of radioactive waste discharges from nuclear industries where they exist. Sea also contains naturally occurring radionuclides of primordial and cosmogenic origin. Both aquatic plants and animals accumulate elements to concentrations greater than those of the ambient water (Akinloye *et al.,* 1999). As a source of food, that aquatic environment provides a large fraction of the diet through aquatic foods of some individual and certain local population. Contamination of fish therefore, constitute a significant pathway for the uptake radiocaesium to man.

The presence of $^{226}$Ra in water constitutes a major source of naturally occurring radionuclide and its content in food contributes significantly to the radiation intake on the general populace (Olomo, 1990). Fruits, vegetables, cereals, and tubers are vital in our diet and presence of natural radionuclides $^{40}$K, U and Th in them have certain radiological implication not only in the foods, but also on the populace consuming these food sources (Fortun *et al.*, 2004). These doses received by a person consuming aquatic foodstuffs, fruits, vegetable depends on the radionuclides consecration of the food and the quantity (Jibiri and Farai, 1998, Farai and Oni, 2002).

## ORIGIN OF THE RADIONUCLIDE IN FOODSTUFFS

Main sources of radionuclides in food stuffs come from artificial radioactive elements, due to the "fallout" i.e., the precipitation or deposition of radioactive elements on terrestrial surface. Superficial tests of nuclear bombs and nuclear reactors accidents caused the appearance of several artificial radioactive element. Leak of nuclear reactors originated local fallouts, that mainly contaminates regions around the nuclear factory. Otherwise, superficial tests using nuclear bombs to originate local, regional or global fallout, depending on the magnitude of the explosion, and the height of the radioactive cloud.

In global scale, radionuclide elements coming from the fallout incorporates in biosphere. These elements present in atmosphere contaminate plants, soil and water and by different ways contaminate the environment. The radioactive elements transport in environment involves transference among three primary components: vegetation, soil and water. (Ritchie and Mchenry, 1990).

Figure 1 shows the cycle of incorporation of $^{137}$Cs in the environment. This model describes several environmental transference processes and biocontamination factors. It shows radionuclides of $^{137}$Cs, nevertheless many other radioactive element have the same behavior.

Figure 3 describes the cycle of radionuclides incorporation in the soil until its final absorption for man. Greatest contamination is achieved when cow graze during fallout periods ingesting pasture grass and soil (Tsukada and Inaba, 2003). Even if they are kept indoors, contamination of milk may occur by inhalation of radionuclides or ingesting them in drinking water and contaminated feed.

**Figure 1: 137Cs Incorporation Cycle Diagram in the Nature**

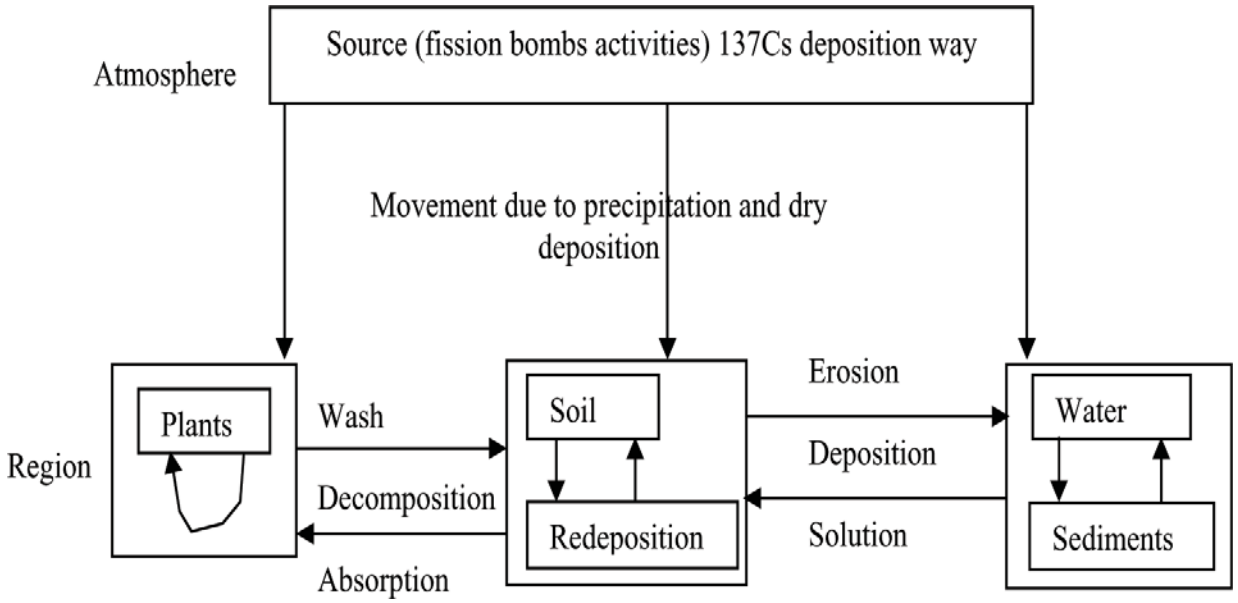
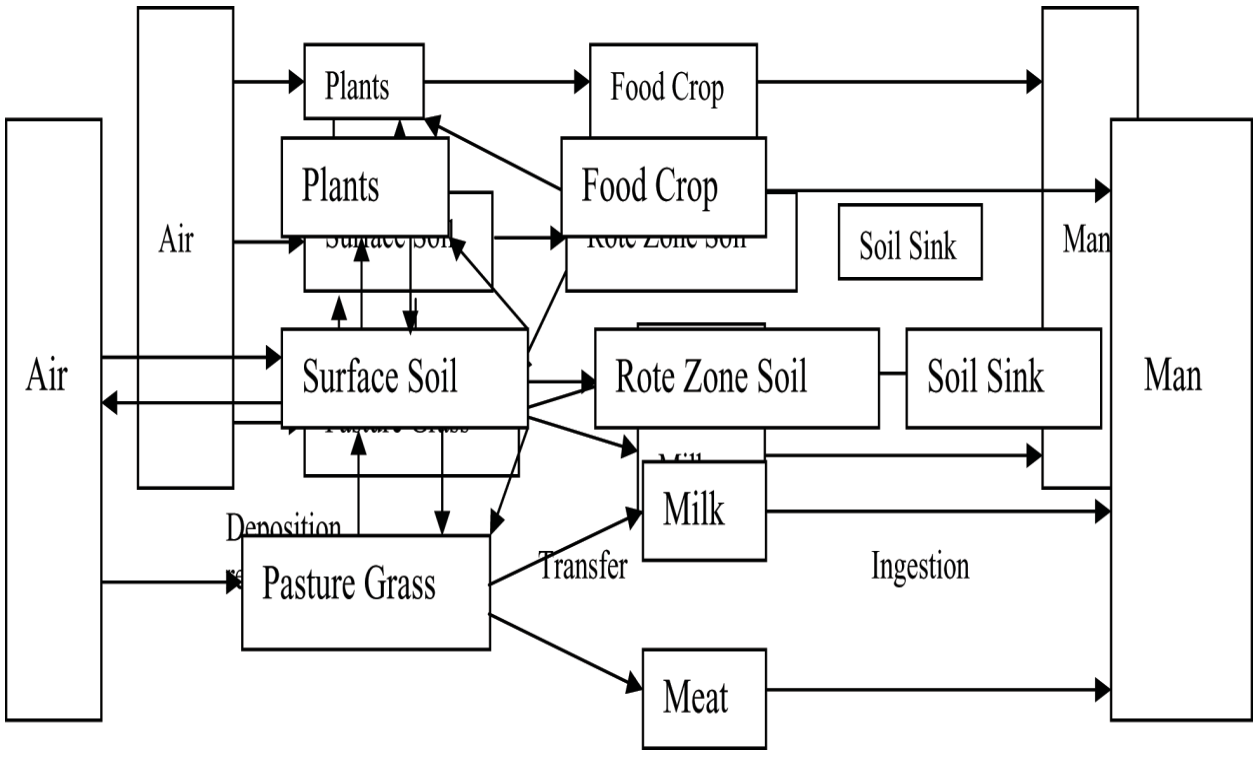



**Figure 2: A Typical Set Of Pathways Through The Environment From A Radiation Source Exposed To The Air**



In Nigeria, the indigenous cattle have been the major source of milk supply. Milk supply from other animals such as sheep, goats and camels is negligible (Ibeawuchi and Dalyop, 1995).

However, there is a grown awareness of the importance of goats as a source of milk for man (Malau-Aduh *et al.,* 2001). Goat milk was analysed for fat, solid, non fat, total solid, cholesterol, calcium, magnesium and phosphorus according to the standard procedures described by Association of Official Analytical Chemists and Pearson's Chemical Analysis of Food. It was concluded that milk from goats is of high nutritional values and can be used to supplement the nutritional status of the rural communities.

Nigeria is not well suited for daily farming, causing nearly all milk to be imported. Since few Nigerians have dependable refrigeration, canned milk is the most effective and dependable source.

Peak milk is a Dutch Company and was the first Dairy Company in Nigeria. It was the first manufacturer, here, of evaporated milk. All the cows in Nigeria could not produce enough milk for peak milk daily operations. Therefore, all milk for the factory is shipped via milk powder from the Netherlands. Reconstitution of the powder is then done at the factory by the addition of water, fats, minerals and vitamins. Hence, the need to examine the radioactive concentration of these import raw milk met for domestic consumption. Artificial radioactivities such as fukrushima disaster, nuclear weapon testing by some countries have occurred recently.

## CONCLUSION

From this work, it can be seen that radionuclides elements such as $^{40}$k, $^{137}$ Cs, $^{226}$ Ra, $^{238}$ U and $^{232}$Th have certain radiological implication not only in the foods, but also on the populace consuming these food sources.

In addition, a long accumulation of high concentration of the natural radionuclides is capable of causing serious health impairment like serious brain damage, weight lost, retina degeneration, hearing impairment and even death.

## RECOMMENDATIONS

It will be advisable that, milk from cow, goat and sheep, should be checked periodically over a longer period because of their grazing habits.

Constant monitoring, i.e., environment auditing of areas should be carried out by government agencies. Further research should be carried out to find out or verify any impact from the ingestion of this radionuclide in the living organisms including humans.

The establishment of radio-isotope concentrations will prove meaningful information that can contribute to knowledge of population exposure and to the setting up of original base line.

Finally, in view of the potentially dangerous effects of radioactive substances, no effort should be spared in their quantitative determination in all the identifiable pathways.

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