



Effect of Natural Radionuclide in Some Selected Cassava Flour in Igboora, Oyo State

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Abstract

Naturally occurring radionuclide's materials are usually absorbed by the plant through root as nutrients for growth, which at times pose a radiation risk to the human when consumed as food. This study focused on the effect of natural radionuclide in cassava flour in Igboora which aimed to determining the amount of dose rate exposure in Cassava flour compared it with UNSCEAR permissible level. The cassava flours was bought from three different Markets in Igboora using random sampling techniques; Towobowo, Oja–Oba and Onilado. Measurement and recording were taken by the use of calibrated Gamma Survey Meter for dose rate of radiation emitted by flours, which was taken place at Physics Laboratory, Oyscatech, Igboora. The mean value of data taken for each market are; Towobowo 0.3005 Bg/kg, Oja Oba 0.4205 Bg/kg and Onilado 0.50775 Bg/kg respectively. Data presented shown with the aid of Bar chart and compared with UNSCEAR permissible dose rate of 0.05-5.50 Bg/kg per year .The results revealed that gamma dose obtained from the measurement indicated that natural radionuclide health risk in cassava flour are well below permissible limit sets by UNSCEAR 2000.It can be concluded that radiation ingestion from consumption of the Cassava flour from the three markets considered will not have effect on human body and pose no risk of cancer related diseases.

Keywords: Cassava flour, Gamma dose rate, Exposure, Radiation, Survey meter, Diseases

Introduction

Radiation is a natural part of the environment in which we live. People receive exposure from naturally occurring radioactivity in soil, water, air and food. The greatest natural radiation exposure received comes from a radioactive radon gas. Radon (²²²Rn) is emitted from uranium, a naturally occurring mineral in rocks and soil; thus, radon is present virtually everywhere in the air over the earth (Hu *et al.*, 2010).

These radionuclides in the natural environment find their way into the human body majorly through food and water. The most predominant naturally occurring radionuclides in foodstuffs is ⁴⁰K (Isinkaye and Faweya, 2006). Other contributions to the radio-nuclides in foods include deposited fallouts from fission and activation products released during nuclear accidents and constituents of weapons tests released after detonation. It is a known fact that the status of the soil on which food crops are grown determines, to a great extent, the quality of foodstuffs produced (Saleh *et al.*, 2007).

Terrestrial radiation level varies from one geographical location to another depending upon the variation of radionuclide concentration in soil which is a function of the local geology (Kalac, 2001). The plant uptake of radiation varies from species to species and from place to place; hence the intake of different food products forms a secondary source of variability in radionuclides concentration ingestion. ²³⁸U, ²³²Th and ⁴⁰K are three long-lived naturally occurring radionuclides present in the earth crust (De Castro *et al.*, 2012).

Naturally occurring radionuclides of ²²⁸Th and ²³⁸U have significant contributions in the ingestion dose and are present in the biotic system of plants, animals, soil, water and air. Distribution of radionuclides in different parts of the plant depends on the chemical characteristics and several parameters of the plants and soil (Antonio *et al.*, 2006).

Natural radioactive elements are transferred and recycled through natural processes and between the various environmental compartments by entering into ecosystems and human food chains.



Foods may be contaminated to some extent as a result of deposition of radionuclides on food crops or on pasture. However, radioactive contamination of the environment may result in the increased radiation exposure of human beings due to ingestion of radionuclides in food (Santos *et al.*, 2002). In the chain of transfer processes which leads from the deposition of radionuclides onto soils and plant surfaces to their presence in the diet, food processing and the various methods of food preparation are the last processes which can affect the radionuclide content of foodstuffs. Man's ingestion of radioactive materials may also result from drinking contaminated water in the environment (Hu *et al.*, 2010).

Also recently an annual effective dose rate of 1.64 mSv due to environmental radiation has been reported for the city (Jibiri, 2001). Metal pollution in shallow well water samples in the neighboring town to the study areas has been reported, radioactivity in borehole water in neighboring state and part of Oyo State (Bikit *et al.*, 2005).

Cassava Plant (*Manihot esculenta* crantz) is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy tuberous root, is a major source of carbohydrates. The cassava root is long and tapered with firm homogenous flesh encased in a detectable rind about 1mm thick, rough and brown on the outside. It is traditionally grown in a savanna climate but can be grown in extreme of rainfall. In most areas, it does not tolerate flooding, in droughty areas, loses its leaves to conserve moisture, producing new leaves when rain resume. It takes 18 or more months to produce a crop under adverse condition such as cool or dry weather. Cassava does not tolerate freezing conditions. Inhalation and ingestion are the main pathways through which natural radionuclides enter into the human body. Tawalbeh *et al.*, (2012), opined that ingested radionuclides could be concentrated in certain parts of the body. For example, Chemical uranium toxicity primarily affects the kidney, causing damage to the proximal tubule, while this metal has also been identified as a potential reproductive toxicant, ²³²Th cause's effect in lungs, liver and skeleton tissues and ⁴⁰K in muscles (Linares *et al.*, 2006).

Depositions of large quantities of these radionuclides in particular organs will affect the

health condition of the man such as weakening the immune system, induce various types of diseases, and finally increase in mortality rate (Tawalbeh *et al.*, 2012). A study by Akpabio and Ituen (2006) attempted to measure the radioactivity level in roots grown in the coastal and hinterlands of the oil producing areas of Akwa Ibom state, Nigeria. The study reported the highest radioactivity level in yam and cassava samples. This may be due to oil activity occurrence in the area.

Addo *et al.*, (2013), investigated natural radioactivity ingestion from cassava grown and consumed by inhabitants around a cement factory in Ghana. The study revealed an annual effective dose of 1.23mSv/y which is above the annual dose limit set by the International Convention for Radiological Protection (ICRP) for the general public, indicating human health risk for the cassava consuming population (Shanthi *et al.*, 2009).

Throughout the centuries, the food preservation techniques have been improving with the increase of scientific development. These methods include freezing, drying, canning, pickling preparation, pasteurization, fermentation, cooling, controlled atmosphere storage, and application of preservatives, and among the emerging technologies, the highlight is the radiation technique. There are various forms of radiant energy emitted in various ways that belong to the electromagnetic radiation spectrum, and these include radio waves, microwaves, infrared radiation, visible light, ultraviolet, X-rays, and gamma rays. These forms of energy differ in the wavelength, frequency, force of penetration, and other effects exerted on biological systems. As can be observed in Figure 1, in general, it can be viewed that in the electromagnetic spectrum, there are two types of radiation: ionizing and non ionizing (Spolaore *et al.*, 2001).

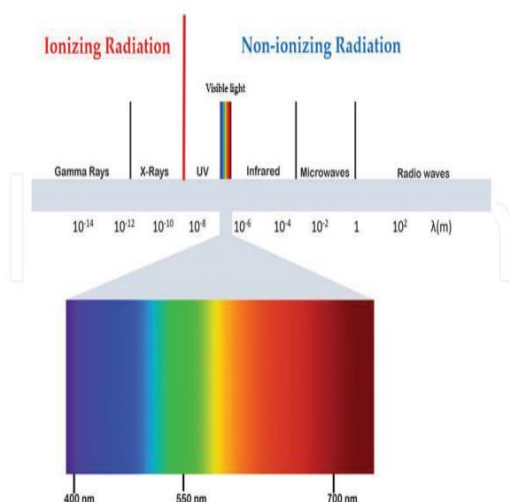


Figure 1. Electromagnetic spectrum.

Statement of Problem

Globally, adequate wellbeing of persons is fundamental to gain certain level of guarantee in terms of food safety and security, reduce food wastage, and enhance feeding with a resulting decrease in nutrition-related sicknesses. Extreme weather conditions, for example, harsh and muggy temperatures, exposure of foods to potential hazards conditions during storage and handling, transportation and conditioning has unfortunately played a role in an increased loss of food. This radionuclide's elements are mainly from the ^{226}Ra and ^{232}Th decay chains and ^{40}K . These radionuclides find their way into the indoor and outdoor air as they decay and tend to affect man. As a result of this it is essential to know the natural occurrence radionuclide elements present in Cassava flour.

Justification of the study

Data on radioactivity concentration of food items are quite limited and attempt has been made to correlate the NORMS in soils and sediments from different areas. Due to economical and social need for exploiting natural resources by means of milling, natural activities, can greatly cause harm to the food items with uptakes of this radionuclides from soil, which may account for substantial fraction of radiation dose to various organs of the body when consumed by Humans.

Aim and Objectives of the study

Aim of the study

This study aimed to measure the effect of natural radionuclide in some selected Cassava flours in Igboora.

Objectives of the study

- To determine the amount of dose rate radiation exposure in Cassava flour
- And compared with UNSCERAR the permissible level

Materials and Methods

The different samples of cassava flours were bought from three different Markets, Towobowo, Oja Oba and Onilado in Igboora, Ibarapa Central Local Government area of Oyo State.

To ensure homogeneity, the dried samples of cassava flours were crushed and pulverized to fine powder using grinding machine. Each of the pulverized samples was weighed by the use of an electronic balance and placed in a labeled container and weighed. The samples were kept in an air-tight plastic container, which had been washed thoroughly with soap and rinsed with distilled water and incubated for a period of four weeks to attain radioactive equilibrium between parents and progenies.

The electrosmog meter which was calibrated in Becquerel per kilogram (Bq/kg) was used to take measurement. It was taken to Physics laboratory, Oyscatech, Igboora to detect the gamma dose rate on each sample. Electrosmog meter was put on the top of the cassava flour sample of about 2 cm distances. The measurement and recording was taken simultaneously in Becquerel per kilogram (Bq/kg). The data collected was tabulated and bar chart was used to present the data

Results and discussion

Results

Table 1: The gamma dose rate of Cassava sample bought from Towobowo Market
Date of measurement day 1: 22-05-2023

X(Bq/kg)	Y((Bq/kg)	Z((Bq/kg)	XYZ ((Bq/kg)
0.365	0.332	0.244	0.261

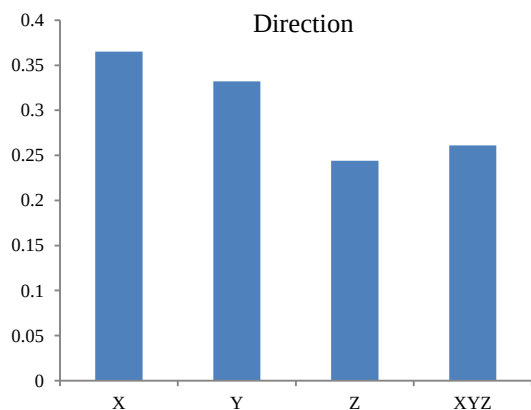
Table 2: The gamma dose rate of Cassava sample bought from Oja –Oba Market
Date of measurement day 2: 23-05-2023

X((Bq/kg)	Y((Bq/kg)	Z((Bq/kg)	XYZ ((Bq/kg)
0.335	0.444	0.362	0.541

Table 3: The gamma dose rate of Cassava sample bought from Onilado Market.
Date of measurement day 3: 24-05-2023

X((Bq/kg)	Y((Bq/kg)	Z((Bq/kg)	XYZ ()
0.654	0.363	0.452	0.562

Bar chart 1



Bar chat 2

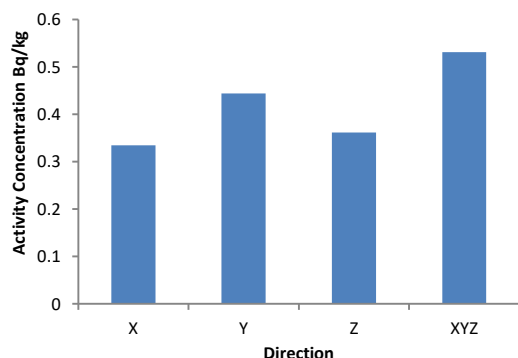


Figure 2: Maximum gamma dose rate (Bq/kg) of radiation emitted from Cassava flour sample from Oja-oba Market

Bar chart 3

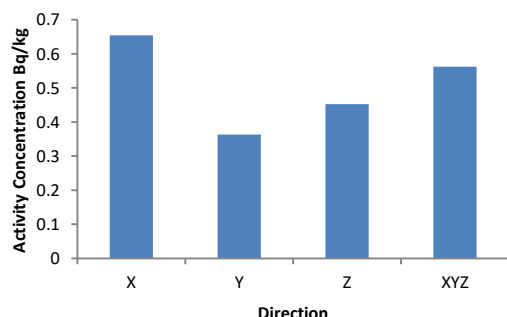


Figure 3: Maximum gamma dose rate (Bq/kg) of radiation emitted from Cassava flour sample from Onilado Market

Table 1 above showed the result of gamma dose rate taken from Cassava flour sampled, in the x, y, z and xyz directions the result indicated from the bar chart that at x direction had the highest dose rate of 0.365 Bq/kg, followed by y direction with dose rate of 0.332 Bq/kg, xyz direction had dose rate of 0.261 Bq/kg and z direction had the lowest dose rate of 0.244 Bq/kg. The observed results corroborated with the findings of Amakom *et.al.*, 2022 who discovered that the gamma dose rate of radionuclides present in common vegetable in Owerri, Imo state Nigeria, lower than the permissible values which indicated consumption safety for those who eat the vegetable.

Table 2 above showed the results of gamma dose rate taken from Cassava flour sampled in the x. y. z and xyz directions, the result indicated that xyz direction had the highest dose rate of 0.541 Bq/kg, y direction had dose rate of 0.444 Bq/kg, z direction has dose rate of 0.362Bq/kg and the x direction gave the lowest dose rate of 0.335Bq/kg. The result agreed with the research work done by Giri *et al.*, 2013 concerning foodstuffs and water ingestion by human beings in India from a uranium mining area revealed that the ingestion dose was below the dose limit of 1mSvyr–1for public exposure in planned exposure situation as recommended by ICRP (2007) indicating that there was no significant radiological health risk to the consumers

Result from table 3 above showed the result of gamma dose rate taken from Cassava flour sampled, in the x, y, z and xyz directions the result indicated that at x direction had the highest dose rate of 0.654 Bq/kg, followed by xyz direction which had dose rate of 0.562 Bq/kg, z had the dose rate of 0.452 Bq/kg and y direction gave the lowest dose rate of 0.363Bq/kg.

It can be deduced that gamma dose rate emitted from cassava flour sampled from Towobowo, Oja oba and Onilado Market, from the measurement of Gamma dose rate and compare with United Nation Scientific Committee on the Effect of Atomic Radiation (UNSCEAR) 2022 permissible level 0.05-5.50 Bq/kg. Therefore, the gamma dose rate of all the sampled Cassava flour fall below the acceptable dose rate of radiation according to UNSCEAR, 2022.

Conclusion

Discussion



From the result, it can be concluded that gamma dose rate obtained from the findings showed that natural radionuclide elements present in cassava flours examined are well below permissible limit set by UNSCEAR 2000. Hence, it can be deduced that the ingestion of natural radiation elements from consumption of Cassava flour from the three Markets (Towobowo, Oja-Oba and Onilado) considered does not have effect on human body and thus, pose no risk of any cancer related diseases.

Recommendation

To reduce the consumption of radionuclide elements in our environment, there shall be proper awareness from Radiation Protection Agency (RPA) on the effect of high radiation on human body on process food to prevent risk that may result especially the health challenges involved.

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