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The Raise in Cancer/Tumor Demography in Kebbi State of Nigeria Is Speculated To Be Caused By Radioactive Nuclides

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ABSTRACT

This research work investigated the speculated presence of radionuclides believed to be the cause of raise in cancer demography in Kebbi State, Nigeria. Gamma ray spectrometer was used to interrogate the samples collected from the field. The result of the activity concentrations of the radionuclides; ^{238}U, ^{232}Th and ^{40}K show thatthe ranges of the activity concentration were found to be 28.7$\pm$1.3 Bq/kg to 63.3$\pm$5.1 Bq/kg, 11.3$\pm$2.5 Bq/kg to 21.2$\pm$2.1 Bq/kg and 171.7$\pm$6.3 Bq/kg to 346.1$\pm$16.3 Bq/kg respectively. The minimum activity concentrations for (^{238}U, ^{232}Th and ^{40}K) were found in A, B and B respectively while the maximum values were both found in E. The values of ^{238}U Bq/kg in B, C and E are greater than the world wide average while that of both ^{232}Th Bq/kg and ^{40}K Bq/kg from A to E are less than the world wide average.Both internal hazard index and external hazard index are below the permissible health hazard index value of 6.0.

Key word: ^{238}U, ^{232}Th and ^{40}K

I. INTRODUCTION

The raise in cancer patients' demography without suggested possible causegave the impetus for this research work. In the cause of investigation, it was observe that this demography hasnot worked or lived in an area associated with high radiation activities.Of the many research work to unmask this mystery, samples were collected from the playground of five schools for radiation analysis.

Naturally Occurring Radioactive Materials, known as NORM, refer to all natural materials in the environment which contain radioactive elements, i.e. radionuclides or radioisotopes. Radionuclides are unstable forms of chemical elements that decay radioactively, causing emission of nuclear radiation (alpha, beta or gamma rays). Release of ionizing radiation during the decay of radionuclides may pose risks to the environment and human health, in particular increasing cancer risk. Some of the radionuclides are also chemically poisonous, such as uranium (Kauppila et al., 2011).

Human beings are exposed to natural background radiation every day from the ground, building materials, air, food, the universe and even elements in their own body. In addition to natural background radiation people are also exposed to, low and high-linear energy transfer radiation from the man-made sources such as X-rays equipment and radioactive materials used in medicine, research and industry, Okelo, 2015.

According to the environmental protection agency (EPA) report (2005), the more radiation dose a person receives, the greater the chance of developing cancer, leukemia, eye cataracts, Erythema, hematological depression and incidence of chromosome aberrations. This may not appear until many years after the radiation dose is received (typically, 10-40 years) Avwiriet al., 2011.

Being soil as one of the environmental samples where NORM is present at varying degree, it is unavoidably to refrain children from getting in contact with the soil during their play in the respective schools playgrounds, increase the occurrence of ailment associated with tumor/cancer and to understand more on the sources of the disease thereby providing solution to the problem justify this research work.This research work covers the assessment of NORM of the aforementioned area, determining the levels of activity concentrations of the radionuclides (^{238}U and ^{232}Th and ^{40}K) as well as evaluating internal and external hazard indices.

II. MATERIAL AND METHOD

Materials used in the research include instruments and tools. Specification of the instrument is summarized in the table 2.1and 2.2.

Table 2.1: Instruments used in this research

Instrument	Specification
Measuring tape	16ft/5m
Global positioning system (GPS)	WDY- 500 A
Digital weighing balance	0.01g
Gamma ray spectrometer	Specified at 662 eV of Cs-137
Oven	220V ± 10 %, 10A, 50Hz, 1 Phase

Table 2.2: Tools used in this research.

Tool	Specification
Hoe	-
Nine litre plastic Bucket	black
Wooden pestle & mortar	-
Mesh	2mm
Shovel	104cm
Plastering Knife	hand shovel gardening 8"
Plastic cylindrical beaker	100ml
Vaseline candle wax	-
Masking tape	24mm/50m

In each field; five soil samples were collected and mixed to obtain a composite sample out of which 3 kg of the samples each were collected for the analysis as adopted by Faanuet al., 2012.the soil samples (A, B, C, D and E) were individually placed in an electrical oven set at a temperature of 105°C to allow for drying overnight in order to remove any available moisture. After drying, the samples were crushed and sieved with a mesh having holes each of diameter of 2 mm in order to remove organic materials, stones and lumps. Thereafter, the homogenized samples were packed to fill cylindrical plastic beakers of 7 cm by 6 cm diameter which is the same as geometry of the counting detector. This satisfies the selected optimal sample container height.

The samples were carefully sealed using Vaseline candle wax and masking tape in order to prevent trapped radon gas from escaping. They were then weighed on the digital weighing balance. Each plastic beaker accommodates approximately 300 g of the soil sample. The sealed samples were kept for a minimum period of 30 days so as to allow for ^{226}Ra and its short-lived progenies to reach secular radioactive equilibrium before gamma counting as adopted by Suleiman et al., 2018.

Determination of activity concentration

Activity concentration of the radionuclides was calculated using the method of comparison for gamma ray analysis, given by the equation 2.1 below. (Mustapha, 1999)

$$\frac{M_s A_s}{I_s} = \frac{M_r A_r}{I_r} \qquad 3.1$$

Where;
M_s = Mass of the sample
A_s = Activity of the sample
I_s = Intensity of the sample
M_r = Mass of the standard
A_r = Activity of the standard
I_r = Intensity of the standard

III. RESULTS AND DISCUSSION

Table 3.1: Activity concentrations of radionuclides measured from the soil of the selectected school playgrounds within the study area

School	GPS coordinate	^{238}U (BqKg^{-1})	^{226}Th (BqKg^{-1})	^{40}K (BqKg^{-1})
A (MagajinGari)	12.460N, 4.209E	28.7±1.3	17.6±2.2	253.5±12.6
B (Baiti)	12.468N, 4.199E	61.6±5.2	11.3±2.5	171.7±6.3
C (HajiyaKubura)	12.455N, 4.193E	51.8±1.9	18.6±1.3	231.8±14.2
D (Bayan Tasha)	12.441N, 4.200E	31.2±1.5	13.6±1.6	251.1±11.5
E (Aliero Quarters)	12.473N, 4.253E	63.3±5.1	21.2±2.1	346.1±16.3

Mean (Average)	47.34±3.0	16.46±1.9	250.84±12.2
Worldwide average (UNSCEAR, 2001)	35	45	420

The results from table 3.1 shows the values of the activity concentrations of the primordial radionuclides; ^{238}U, ^{232}Th and ^{40}K. The ranges of the activity concentration were found to be 28.7±1.3 Bq/kg to 63.3±5.1 Bq/kg, 11.3±2.5 Bq/kg to 21.2±2.1 Bq/kg and 171.7±6.3 Bq/kg to 346.1±16.3 Bq/kg respectively. However, the geometric means were respectively obtained as 47.34±3.0 Bq/kg, 16.46±1.9 Bq/kg and 250.84+12.2 Bq/kg. The minimum activity concentrations for primordial (^{238}U, ^{232}Th and ^{40}K) were found in A, B and B respectively while the maximum values were both found in E. The values of ^{238}U Bq/kg in B, C and E are greater than the world wide average while that of both ^{232}Th Bq/kg and ^{40}K Bq/kg from A to E are less than the worldwide average.

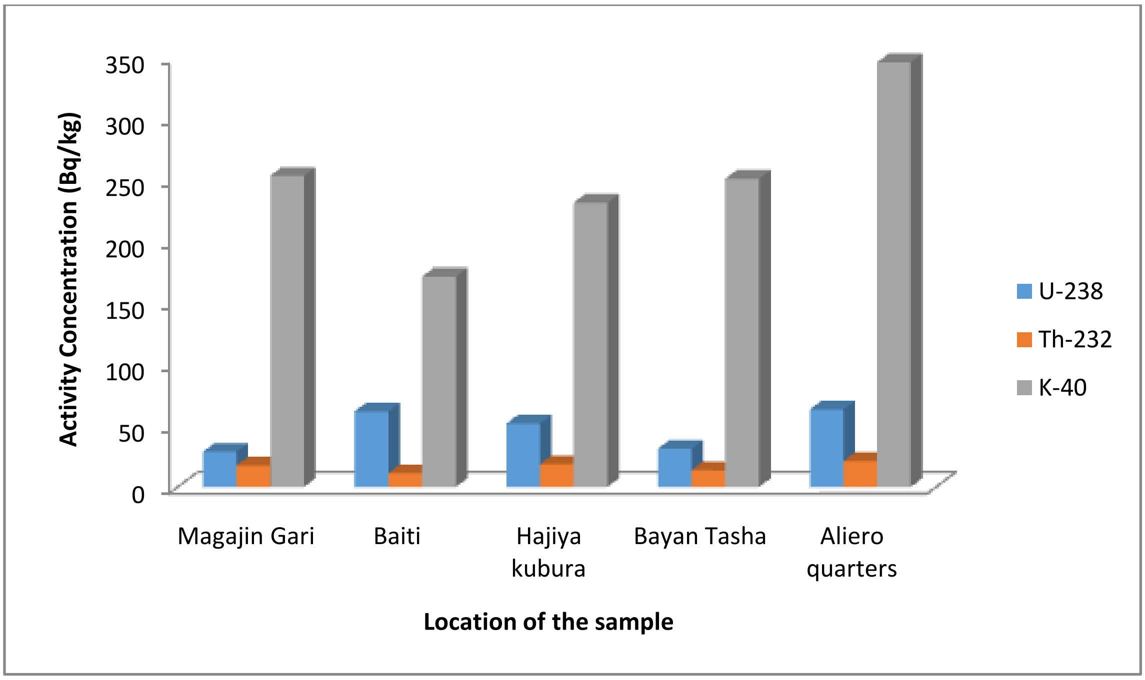

Figure 3.1:A bar chart of the activity concentration of the three primordial radionuclides of the samples collected from the surveyed area.

The activity concentrations for ^{238}U and ^{232}Th were found to be highest at Aliero quarters as shown in Figure 3.1, this could be attached to the presence of some hills around it's neighborhoods of Zauro and Kardi towns which are not found in the remaining sample areas. However, there may be other geological constituents in addition to the aforementioned. In all the soil samples, ^{40}K had the highest activity concentration, this is due to the fact that ^{40}K is the most abundant radioactive element under consideration and its concentration is relatively high due to its long half-life compared to ^{238}U and ^{232}Th (Wairimu, 2015)

Radium equivalent

Table 3.2 shows the calculated radium equivalent activity of the samples. The average radium equivalent activity was found to be 90.1695 Bq/kg, the radium equivalent value minimum of 69.9827 Bq/kg and maximum of 120.2660 Bq/kg were found in D and E i.e. Bayan Tasha and Aliero Quarters. The values of the radium equivalent in B, C and E were 112.33%, 108.12% and 135.13% respectively which is greater than worldwide average. However, the mean average value of radium equivalent activity of the study areas was 90.1695 which is slightly higher than the world average of 89 Bq/kg but below the permissible

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healthy limit of 370 Bqkg-1 (Beretka and Mathew, 1985). Figure 2 shows the levels of radium equivalent activity of three natural radionuclides measured in this work.

Table 3.2: Calculated Radium equivalent activity of the radionuclides in the samples

Sample	**Ra_{eq}(Bq/kg)**
A (MagajinGari)	73.3875
B (Baiti)	90.9799
C (HajiyaKubura)	96.2312
D (Bayan Tasha)	69.9827
E (Aliero Quarters)	120.2660
Mean (Average)	90.1695
World average	89
Acceptable safety limit	370

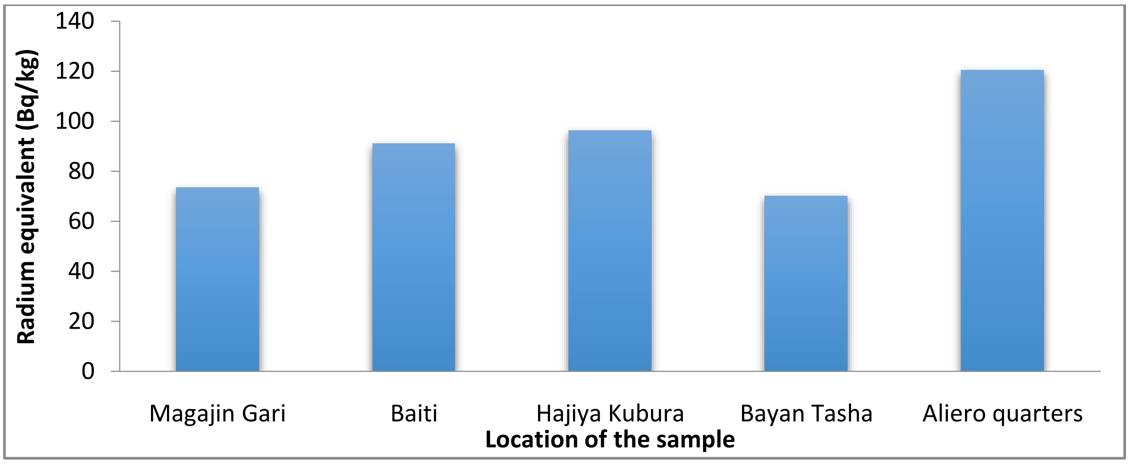

Figure 3.2:A bar chat of the radium equivalent activity of the radionuclides in the samples

The chart presented in Figure 2 shows that Aliero quarters has high radium equivalent compered to MagajinGari, Baiti, HajiyaKubura and Bayan Tasha

Hazard indices

Table 3.3 shows the internal and external radiation hazard indices of the radionuclide in the respective samples. The average value of external hazard index (H_{ex}) was found to be 0.2436 within a minimum of 0.1890 in sample D and maximum value of 0.3249 in sample E. The internal exposure to carcinogenic radon and its short lived progeny is quantified by the internal hazard index (H_{in}), which it average value was found to be 0.3715 within a minimum of 0.2734 in sample D and 0.4960 in sample E as well. The internal hazard index is higher than the external hazard index because the short lived radon is exhaled and concealed in a room and thus increasing the concentration. Figure 4.3 shows the comparison of external and internal hazard indices obtained in their respective sampling sites.

Table 3.3: External and internal radiation indices.

Sample	**H_{ex}**	**H_{in}**
A (MagajinGari)	0.1982	0.2758
B (Baiti)	0.2458	0.4123
C (HajiyaKubura)	0.2600	0.4000
D (Bayan Tasha)	0.1890	0.2734

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E (Aliero Quarters)	0.3249	0.4960
Mean (Average)	0.2436	0.3715
World average (UNSCEAR, 2000)	1	1
Acceptable safety limit (UNSCEAR, 2000)	6	6

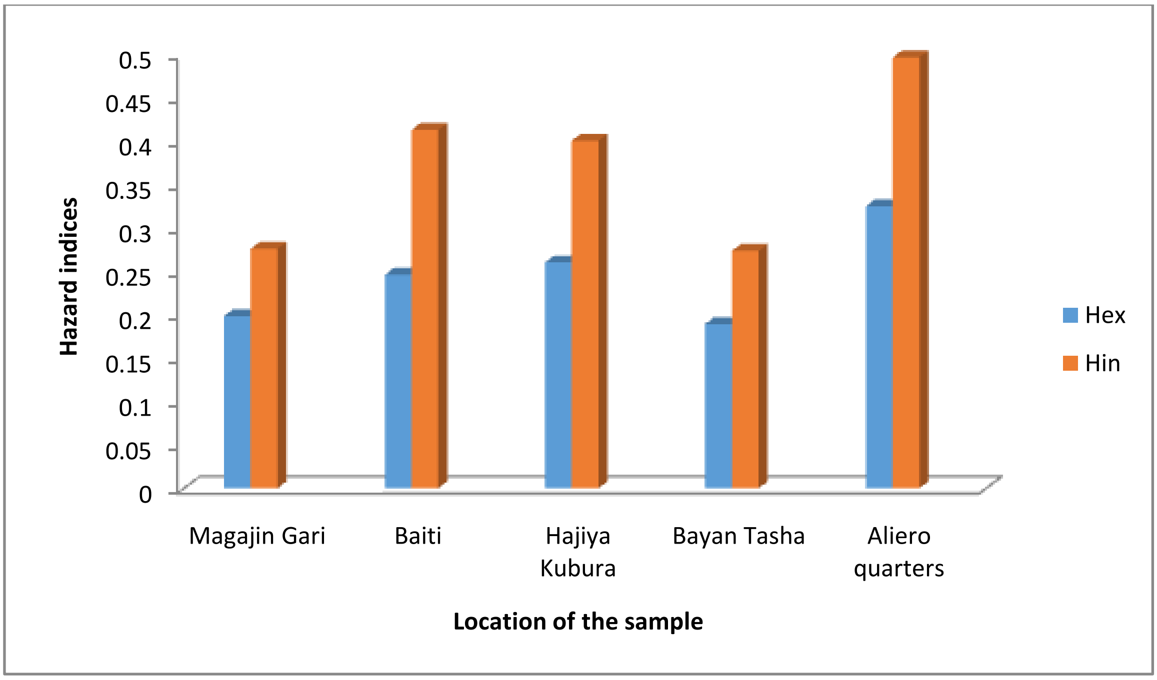

Figure 3.3: A bar chat of the External and internal radiation indices.

According to European Commission, (1999), values of index He≤ 2 corresponds to a dose rate criterion of 0.3 m Sv y-1, whereas 2≤ He ≤ 6 correspond to 1m Sv y-1 indicating that both internal hazard index and external hazard index are below the permissible health hazard index value of 6.0.

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