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Radioactivity Of Dumpsites Within Selected Towns Of Benue And Plateau State, North Central Nigeria.

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Abstract: *The annual radiation dose rate from dumps sites across selected towns in North Central Nigeria was measured using a portable radiation meter scientific rad G-10 and inspector Alert (06250). Result of the investigation revealed that the dumpsites recorded annual mean radiation dose of 2.655 ± 0.584 mSv/yr in Jos metropolis; 0.144 ± 0.016mSv/yr in Makurdi metropolis; 0.318 ± 0224 mSv/yr in Otukpo metropolis; and 0.281 ± 0.06 mSv/yr in Gboko metropolis. Site in almost all the metropolises considered were below the average background radiation in some Nigerian cities and the Nigerian main terrestrial animal's effective dose rate of 24.6μSv/yr; UNSCEAR (2000) safety limit of 2400μSv/yr and ICRP(2009)permissible limit of 1mSv/yr except for Jos metropolis. This implies that radiation related illness are likely to be found among the inhabitants of Jos metropolis. The significant annual radiation dose rates recorded from all metropolis suggest that proper attention should be given to the management and location of dumpsites within Benue and Plateau States. Environmental radioactivity surveillance program is therefore recommended to create awareness on the possible health effects and to provide information that will guide radiation protection scientist and environmental waste managers on the appropriate waste management strategies.*

Keywords:*Background radiation, Radiation Exposure, Radioactivity, Dumpsites, Health/Environmentalhazards.*

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I. Introduction

Environmental radioactivity originates from naturally occurring radioactive materials and enhanced source, such as radioactive waste from mining industries, atomic weapon taste, medical procedures etc. (Hendrickson and Maillie, 2003).These materials may gain access into man via two main critical pathways; the external irradiation (gamma rays) and internal irradiation (inhalation of radon gas) from ore dust and by ingestion of radionuclides contaminated food (Oladapoet al., 2012).

Dumpsites constituents are not only environmental and public nuisance but, also serve as a source of radiation due to the accumulation of radionuclide's in them (Olubosede et al., 2012). These are known to emanate from domestic, agricultural, industrial waste as well as vegetation and surface soils within the dumpsite (Akinloye and Olomo, 2005). Some radioactive by-products from Uranium series such as radon gas seeps out of its ore into the atmosphere and into ground waters and can accumulate with dwellings. It has a short half-life of four (4) days and decays into solid particulates radium series. When these particulates are inhaled they remain lodge in the lungs causing continues exposure. the move to radiation dose a person received the greater the hence of developing radiation related health effects such as Cataracts, Erithemia, Hematological depression and incidence of Chromosomes aberrations (Ouwiri and Ononugbo, 2012).

The use of tailings for baking and frying as well as for plastering of houses by the inhabitants could result in exposure to radiation from radioactive materials within the tailings (waste) which may in turn contaminate soils in the vicinity of the dumpsite (Solomon, 2005). Environmental radioactivity monitoring is usually performed for the purpose of assessing the radiation doses to the general public from natural and man-made/enhanced sources. In public health management of radiation emergencies, one of the essential components of integrated assessment is the timely and accurate as well as categorization of the exposure. Thus, the knowledge of radiation sources in an environment is paramount (UNSCEAR, 2000; Sadiq and Agba, 2011 and Drek et al., 2010). This work seeks to assess the annual radiation dose rate emanating from dumpsites within selected towns of Benue and Plateau States.

II. Method

Measurement Procedure

The radiation levels of the dumpsite were measured using a radiation meter [scientific Rad G-10]. The radiation meter was held at 1 meter above the dumpsite and moved round the dumpsite radius. Five (5) readings were obtained and the average dose rate and measurement errors were computed.

The annual dose rates were computed using (UNSCEAR, 1998).

$$E_0 = n\left(\frac{\mu Sv}{hr}\right) x\, 8760\ {}^{hrs}/_{yr}\ x\, 0.2 \quad (1)$$

Where E_0 is the annual effective dose.

III. Results

Table 1: Annual effective dose from dumpsites in Jos Metropolis

S.No	Sites	Code	Dose rate
1	D. Gyang Co. Ltd Jos	A_J	1.509±0.0335
2	D.K EjinKoren Nig. Ltd Jos	B_J	4.1236±0.0379
3	Climi Mines Ltd. Jos	C_J	1.0922±0.0278
4	Geo Mineral & Resources Ltd Bukwu	D_J	2.4790±0.0627
5	Don Chyke Miner Ltd. Bukwa	E_J	6.3448±0.0580
6	D.B. Zang Ltd. Gyel. Jos South	F_J	2.7245±0.0580
7	Gindiri Mines Ltd. Jos South	G_J	2.8226±0.0208
8	Ratagun Mining Co. Ltd. Jos North	H_J	1.4726±0.0741
9	AngonaNig Ltd. Jos North	I_J	1.2272±0.0642

Range: 1.0922±0.0278 – 6.344 ± 0.0580 mSv/yr
Mean: 2.655 ± 0.584 mSv/yr

Table 2: Annual effective from dumpsites in Makurdi Metropolis

S.No	Sites	Code	Dose rate
1	High Level	A_m	0.196±0.014
2	Modern Market Rd	B_m	0.147±0.008
3	Kanshio	C_m	0.113±0.014
4	Wurukum	D_m	0.098±0.014
5	Wadata	E_m	0.147±0.012
6	North Bank	F_m	0.162±0.012

Range: 0.098±0.014 – 0.196 ± 0.014mSv/yr
Mean: 0.144 ± 0.016mSv/yr

Table 3: Annual effective from dumpsites in Gboko Metropolis

S.No	Sites	Code	Dose rate
1	Gboko Main Market	A_G	0.2838±0.0110
2	Central Police A Division Quarters	B_G	0.3224±0.0113
3	AbaguRoundabout	C_G	0.3031±0.0070
4	Hausa Quarters Gboko South	D_G	0.2400±0.0015
5	Anglican Sec. Sch.	E_G	0.2540±0.0260

Range: 0.2400±0.0015 – 0.3224 ± 0.0113mSv/yr
Mean: 0.281 ± 0.016 mSv/yr

Table 4: Annual effective from dumpsites in Otukpo Metropolis

S.No	Sites	Code	Dose rate
1	Eupi	A_o	0.0929±0.0020
2	Ojira	B_o	1.1949±0.0140
3	Otiya	C_o	0.1051±0.0100
4	Emateyi	D_o	0.1254±0.0170
5	Sabongeri	E_o	0.0736±0.0080

Range: 0.0736±0.0088 – 1.1949 ± 0.0037mSv/yr
Mean: 0.318 ± 0.224mSv/yr

IV. Analysis And Discussion

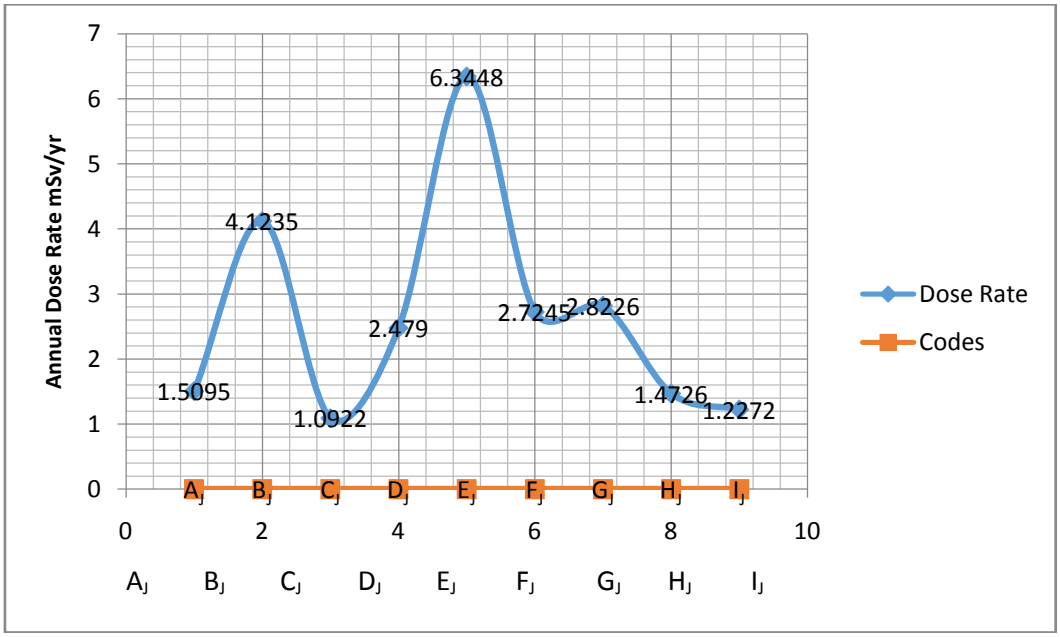

Fig 1: Variation of annual dose rate with sites in Jos metropolis

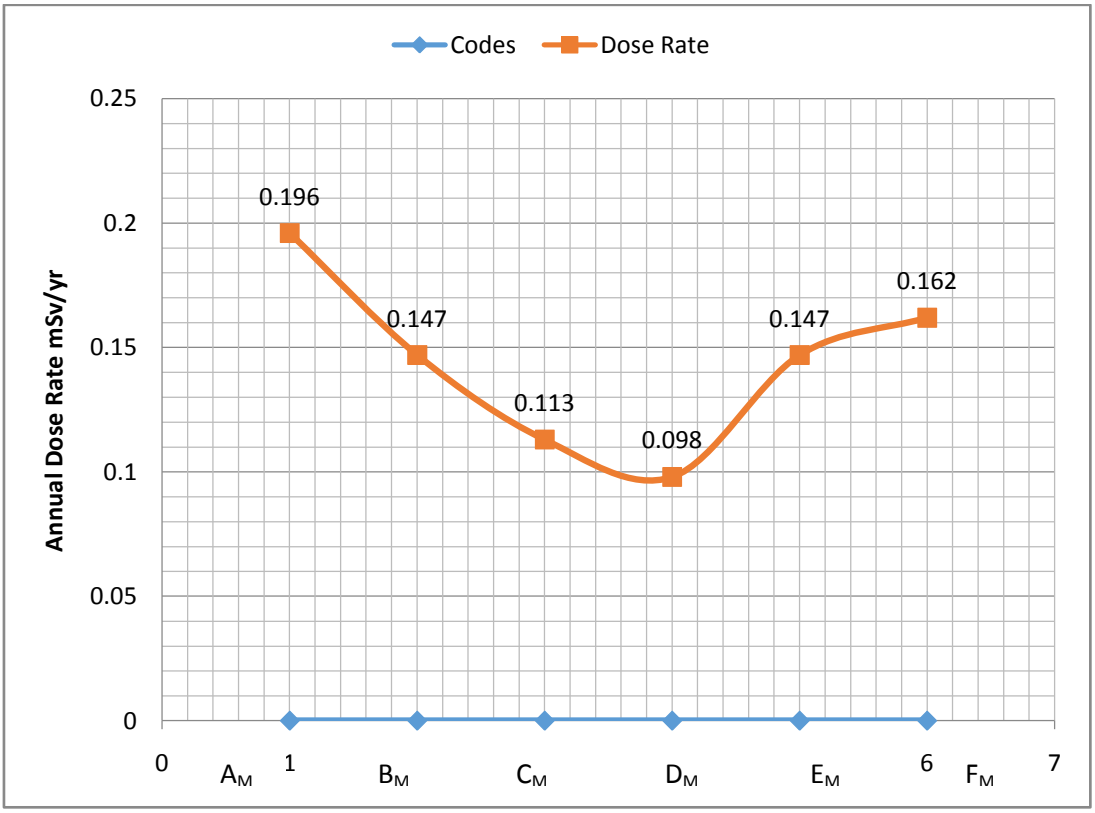

Fig 2: Variation of annual dose rate with sites in Makurdi metropolis

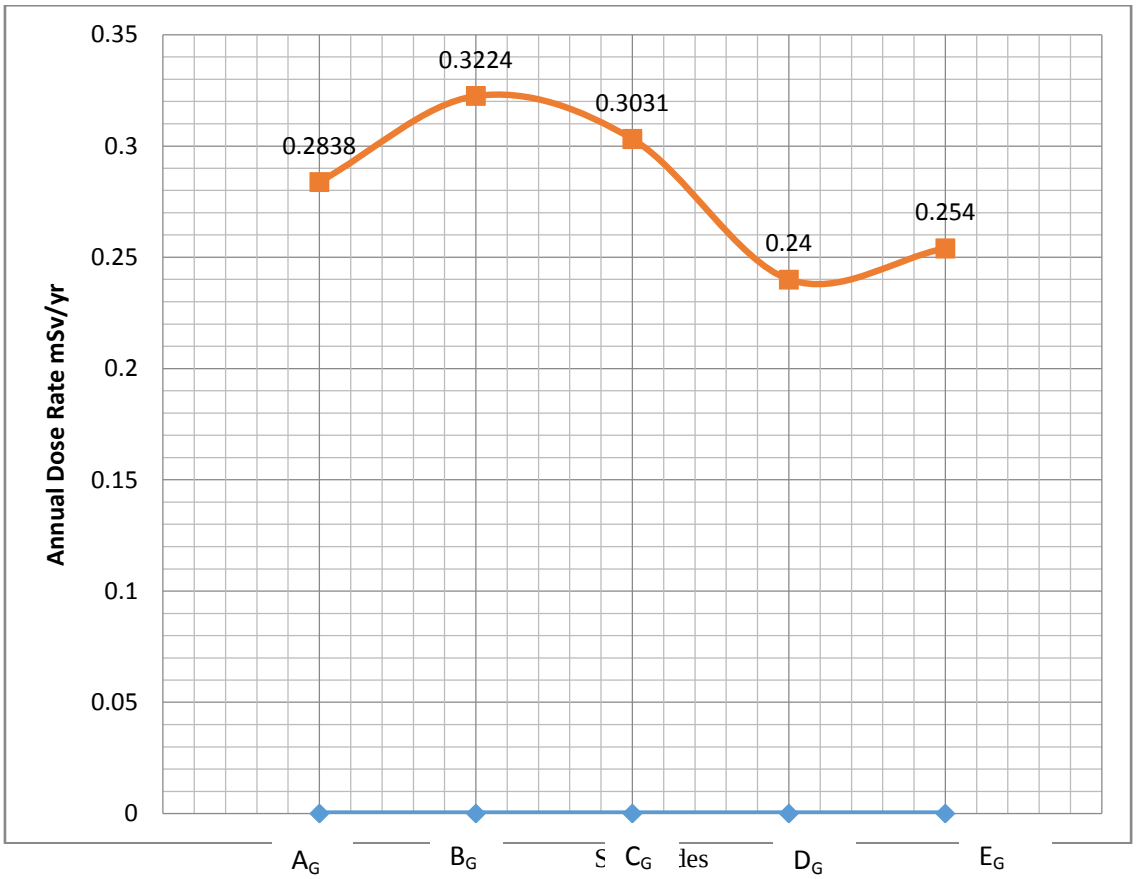

Fig 3: variation of annual dose rate with sites in Gboko metropolis

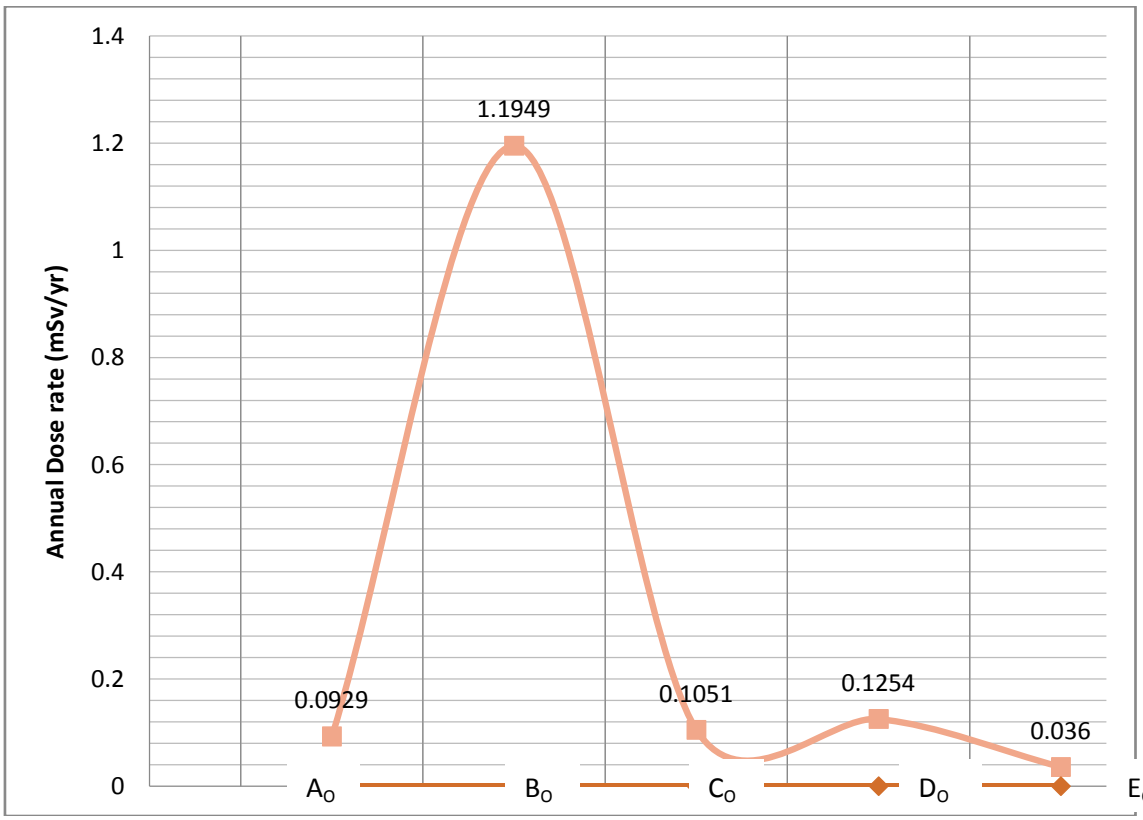

Fig 4: Variation of annual dose rate with sites in Otukpo metropolis

Discussion

The measured annual dose rates at various dumpsites in Jos, Makurdi, Gboko and Otukpo metropolis are presented in Table/ Figure 1-4. The annual dose rates ranged from 1.092 ± 0.028 – 6.344 ± 0.0580; 0.098 ±0.014 – 0.196 ± 0.014; 0.240 ± 0.002 - 0.322 ± 0.011; and 0.074 ± 0.008 – 1.195 ± 0.014 mSv/yr with mean values 2.655 ± 0.584; 0.144 ± 0.016; 0.281 ± 0.016 and 0.318 ± 0.224 mSv/yr respectively for Jos, Makurdi, Gboko and Otukpo metropolises. All dumpsites investigated in Jos metropolis recorded dose rate above the ICRP (1990) permissible limit of 1mSv/yr and UNSCEAR (2009) permissible limit of 0.07mSv/yr. The high dose rates from the investigated dumpsites within Plateau State may be due to granitic formation of Jos soils which contains natural radionuclide's and the sporadic spread of tailing in the vicinity of the Tin mining environments. These tailings are known to contain minerals like magnetite, zircon, silicon, thorits and monazite etc. (Usikalu et al., 2011; Ngyang, 2007). The use of tailings for baking and frying as well as plastering of houses by the inhabitants of Jos metropolis could result in dumping of the ruminant of these tailing and its products to the dumpsites. Hence, the observed high annual effective dose rates.

Dumpsites in Makurdi, Gboko and Otukpo metropolises recorded values lower than permissible limits of 1mSv/yr and 0.07 mSv/yr set by ICRP (1990) and UNSCEAR (2009) except dumpsites in Ojira (Otukpo metropolis) which recorded annual dose rate of 1.1949 ± 0.0140 mSv/yr. Although this high dose rates are within the range reported for background radiation level of most Nigerian cities by Ramli et al., 2014. Recent research by Sombo et al., (2016) on "Radionuclide content of surface soils in Guma Local Government Area which shares border with makurdi metropolis reported a mean annual dose rate values of 0.01mSv/yr for urban and rural areas while Ayaakaa et al., (2016) in their research on "Assessment of radioactivity level of surface soils in Gboko Local government area of Benue and Health implications" reported a mean annual dose rates values of 0.01mSvy^{-1} for urban areas and 0.02 mSvy^{-1} for rural areas. These values are far lower than the annual effective dose rates values recorded in this work. Although studies regarding the composition of the dumpsite was not covered in this work but, the result of the work suggests the existence of traces of radio-nuclides in the dumpsites which could be from domestic, agricultural or industrial waste. Inhabitants that reside close to the dumpsite are likely to receive high radiation doses which could expose them to health risk associated with radiation exposure.

V. Conclusion

The result of this work revealed that Makurdi, Gboko and Otukpo metropolis have annual dose rates higher than the UNSCEAR, (2009) safety limits of 0.07 mSv/y but lower than ICRP (1990) limit of 1mSv/yr . Jos metropolis recorded value above all these safety standards. The mean annual dose of 2.655 ± 0.584mSv/y; 0.144 ± 0.016mSv/y; 0.281 ± 0.016 mSv/y; and 0.318 ± 0.224 mSv/y were recorded in Jos, Makurdi, Gboko and Otukpo metropolises respectively. This shows that the investigated dumpsites have traces of radionuclides. Thus, have the potentials of causing radiation related injuries/ ailments to the general public.

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