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Estimation of Radiation Level Emitted from Waste Dumpsites in Mubi North Local Government Area Adamawa State

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ABSTRACT

Increase in human population of major cities increases the rate and volume of waste generated. These wastes are either recycled or put in waste dumpsite which at times are close to human settlements. This study is to evaluate the exposure rates of gamma radiation in some waste dumpsite located in Mubi north area of Adamawa State and compare it with the world daily mean human radiation by the United Nation scientific committee on the effects of atomic radiation (UNSCEAR) specifications. The natural radioactivity emission from five different locations of waste dump sites have been measured using radionuclide monitor (Gieger Muller). The value recorded is ranged between 0.0l4mR/hr and 0.0l8mR/hr is high compare to UNSCEAR standard World average which is 0.015mR/hr.

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I. I NTRODUCTION

Refuse dump site constitute an environmental health hazard to the public in major cities of the world not only in terms of the odors or the presence of disease-causing micro – organisms, but the radiation emanating from such dump sites (Ojoawo et al 2011). In the past few decades, nuclear applications have been on the increase worldwide and so is the risks of abuse and accident. It is therefore important to measure the levels of the different components of radiation present in the environment at a given time in order to adequately assess the risk to the population. Many forms of this radiation are encountered in the natural environment while some are produced by modern technology.

Most of them have the potential for both beneficial and harmful effects. Even sunlight, the most essential radiation of all, can be harmful when it is in excess amounts.

Most public attention is given to the category of radiation known as ‘ionizing radiations”. These radiations can disrupt atoms, creating positive ions and negative electrons, and cause harm (Avwiri & Esi, 2014). Ionizing radiations include X-rays, gamma rays, alpha particles beta particles, neutrons and the varieties of cosmic rays. All ionizing radiations, at sufficiently large exposures, can cause cancer (Crosbie & Gittus. 2003). Many in careful controlled exposures are used for cancer therapy. Thus, radiation is an old and familiar if unrecognized, pollutant.

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We live in a society where there is indiscriminate disposal of refuse. Not until we awake to our responsibilities and curb this menace, our society is potentially at risk of radiation hazard.

Gamma radiations are radiations without charge (i.e neither negatively nor positively charged) but characterized by a very high penetration ability. Unlike X-rays, alpha and beta rays which are all ionizing radiations. Some plastics, casings (especially electronics casings), disposal from abattoirs, refuse from homes, offices, industries, mechanical and electrical workshops are the major components of municipal waste in most places. Amazingly, they are possible sources of radioactive materials which in turn may become sources of gamma radiation (Avwiri *et al.,*, 2014). Exposure to sources of radiation could lead to acute radiation doses which can be a milestone into the proliferation of cancer in the community (Yves & Alessandra. 2009). Most naturally occurring radio nuclides are potential sources of gamma rays, particularly Potassium 40 which is present in meat, banana, mushroom, avocados etc. and they form part of the constituents of refuse in most dumpsites in Mubi North local government area.

Gamma radiation can cause alteration in the chemical composition of the soil, alter plant physiology, pose a threat to aquatic life and can affect human genetically (Fardous *et al*., 2013).

The main aim of this work is to measure the average amount of gamma radiation emitted from some selected refuse dump site in Mubi North local government area and to calculate the average radiation emitted from the dumpsite and compare it with the world daily mean human radiation by the United Nation's Scientific Committee on the effects of Atomic Radiation (UNSCEAR) specifications.

EMPIRICAL REVIEW

The discovery of gamma ray was done by the French physicist and chemist Paul Villard Ulrich and later classification and naming was done by Ernest Rutherford in 1903. This opened the door of scientific research, experiences, articles, books, and other academic materials have been documented with regards to finding out the amount of gamma radiation in our environment using different methods and monitoring instruments round the world. Therefore, some of the benchmark experiments and researches made to determine the amount of radiation will be reviewed.

Wilhelm Conrad Roentgen (1845-1923) was the discoverer of X-rays. In 1895 he was working on an experiment on vacuum tubes when he saw that fluorescent screen on a nearby table started to glow. Roentgen determined that the fluorescence was caused by invisible rays originating from the vacuum tube. Unlike other rays known at the time (such as light) found to be 29.80 4μSv/hr, 28.5μSv/hr, 19.25 1μSv/hr, 17.53 μSv/hr, and 15.78 μSv/hr. Aku and Augustine (2012) measured the gamma radiation dose rate in cement used in Nigeria for

building. The instrument used for this measurement was the gamma ray spectroscopy and results were found to be I884±&133 Bq/Kg, 57.48±13.37 B/JKg and 679.58±6.13 Bq/Kg the average estimated dose rate values for cement sample was 7196±11.39 nG/hr. (Adesami, *et al.,*2012) measured the radiation dose rate level around a nuclear establishment in Abuja North-Central. The radiation measurement was earned out using RDS-200 universal survey meter. It was observed that the dose equivalent rate varied from 0106±0.032μSv/hr to 0.212±0.0036 μSv/hr with a mean of 0.149±0.032 μSv/hr.

Moses *et al.,* (2013) assessed the gamma dose rate in Idu industrial area of Federal Capital Territory (FCT) Abuja. The measurement was carried out with a radiation monitor Atomex AT11 7m with serial number 14199. It was observed that the average dose equivalent varied from 0.106±0.001μSv/hr to 0139±0.004 μSv/hr with a mean of 0,177±0.006μSv/hr Bamidele (2013) measured ionizing radiation level in a high-altitude town of Imesi-Ile Osun State South-Western Nigeria. The measurement was carried out using Portable Digilert to Nuclear Radiation monitor. The absorbed dose rate obtained ranged from 26.4-48.6 nGy/hr with a mean value of 37.19 nGy/hr Emelue *et a1.*, (2013) measured radiation from refuse dumpsites in Owerri, Nigeria. The natural radioactivity from 40 different waste dumpsites in Owerri was measured using a gamma ray spectrometer. The results showed the ranges of activity concentration of ^{40}K, ^{226}Ra, and ^{323}Th. In the samples were <17.2 — 686.17 Bq/Kg, <4.2— 103.51 Bq/Kg and 5.1 — 65.28 Bq/Kg respectively. The highest outdoor effective dose obtained was 65.28 μSv/hr.

Arvwiri and Emmanuel (2014) evaluated background radiation levels in some selected dumpsites in North Local Government Area of Uvwie, Udu and Ugheli, Delta State. Nigeria. Background ionization radiation measurements were carried out in five dumpsites, An *In-situ*, measurement was done using a well calibrated nuclear radiation Radalert - 100 and a Geographical Positioning System (GPS). Readings were taken once in a week for one month in ten different locations within each of the dumpsites. The mean background ionization radiation values in all the five dumpsites ranges from 0.01 7±0.006 mR/hr to 0. 18±0.007 mR/hr. All the background ionization levels obtained values exceeded the normal world average background ionization Radiation (BIR) level of 0.0 13 mR/hr. The mean absorbed dose rate values ranges from 1.430 mSv/yr to 1.541 mSv/yr. The result showed that all the dumpsites yearly absorbed dose rate exceeded the 1.0 rnSv/yr maximum permissible limit recommended for the public and non-nuclear industrial environment by international council on Radiological protection (ICRP, 1999). Their work indicated that these dumpsite areas of Delta State had background radiation exceeding the permissible limit.

An assessment of environmental radioactivity was done in some selected dumpsites in Port Harcourt, River State, Nigeria. Radionuclide concentration from selected dumpsites within Port Harcourt was determined. *In-situ* measurements were carried out using Radalert Nuclear Radiation Monitor and a Geographic Positioning System (GPS). Two soil samples each from ten selected dumpsites were collected. Gamma ray spectrometry analysis was carried out on them to determine specific activity using NaI(Ti) Scintillation detector.

METHODOLOGY

Mubi North has a major refuse – dump site along Wuro Gude river adjacent to new bridge, and minor dump sites at different locations all around the town. More on the Mubi metropolis, has been extensively explain by (M. A. et al., 2014). Five refuse dumpsites were selected at different locations. To collect data from the five located dumpsites, the radiation alert monitor will be placed in a plastic casing that will be constructed to block other background radiation from penetrating in through the mica window to the GM-tube. On approaching site, it should be mounted on a wooden stand one meter high and moved across the refuse heap. The audio knob was turned on and counts were noted per minute (CPM) and the readings were recorded as the needle indicator deflects through the scale. This was done once in a week in all the five-refuse site in Mubi North local government area.

The mean of each dumpsite is calculated using the simple mean equation.

Mean $x = \frac{\sum fx}{\sum f}$ Where $\sum f$ is the summation of frequency of each data for the entire period.

And the standard deviation is calculated using the equation Standard deviation

$$\sqrt{\frac{\sum x_{i-1}^{n} fi(x_i - \overline{x})^2}{\sum f}}$$

To get the signal, a radiation alert monitor was used to sense ionizing radiation by means of a GM (Geiger-Muller) tube with a thin mica end window. The tube is fully enclosed inside the instrument. When a ray or particle if ionizing radiation strikes the tube, it is sensed electronically and displayed by a flashing count light.

i) Instrument Specifications

This device is used to detect alpha down to 2.5 MeV; typical detection efficiency at 3.6MeV is greater than 80%. And also detects beta at 50KeV with typical 35% detection efficiency. It detects X-rays and Gamma rays down to 10 KeV typical (uncompensated), and also X-ray and gamma rays down to 40 KeV through the sidewall (compensated). Normal background is approximately 10-20 CPM. The operating voltage for the radiation alert monitor is 7-11 volts DC. The temperature range is -20°C to +50°C. The battery has a life span of up to 2000 hours. The power requirement is 9v battery.

RESULTS

The results of the radiation records in all the identified study dumpsites were presented as in

table 1 The component bar chart (figure 4.1) is the plot of the results.

Table 1: The results of radiation records from the study area

Dumpsite	Days	BIR ($mRhr^{-}1$)
Location I (Wuro gude Area river side)	I	0.015
	II	0.013
	III	0.016
Average		**0.004**
	I	0.015
	II	0.017
	III	0.015
Average		**0.037**
Location II (Barama ward, after polytechnic gate)	I	0.015
	II	0.013
	III	0.017
Average		**0.033**
Location III (Opposite Mubi North Police Station)	I	0.017
	II	0.017
	III	0.015
Average		**0.005**
Location IV (Close to Kolere Primary school0	I	0.013
	II	0.015
	III	0.015
Average		**0.003**

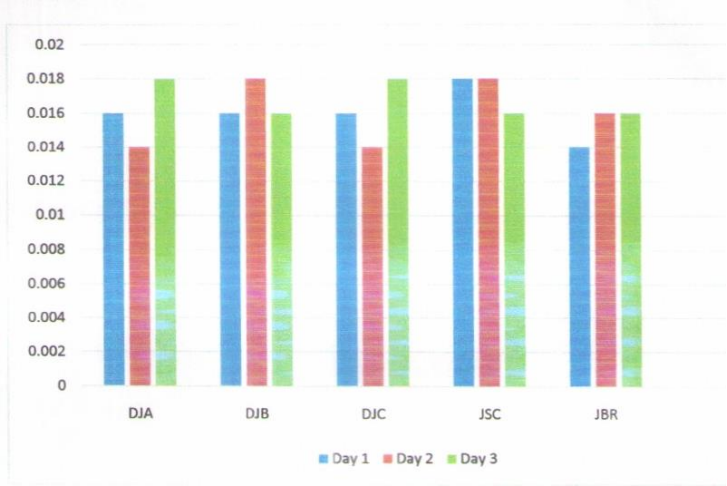

Figure:1 A component bar chart showing the data for each day in comparison with the Standard BIR level (BIRS-Background Ionizing Radiation Standard)

From the result of radiation records of the study area, the group data of radiation records can be obtained by comparing the mean BIR levels with the standard levels as shown in Table 4.2.

Table 2: Group data of the result of radiation records

x	f	fx	x	$d^2(\times 10^{-6})$	$fd^2(\times 10^{-6})$
0.013	3	0.126	-0.004	2.00	11.00
0.015	6	0.09	0.065	0.00	0.00
0.017	5	0.085	0.068	3.00	18.00
$\sum f = 14$		$\sum f = 0.129$			
$\sum fd^2 = 29.00$					

Mean = $\overline{x} = \frac{\sum fx}{\sum f}$ Where $\sum f = 0.228$

$$\sum f = 14\,\overline{x} = \frac{0.129}{14} = 0.00921$$

$$\approx 0.00\ mR/hr$$

The standard deviation S, can be calculated thus:

S = $\sqrt{\frac{\sum_{i-1}^{n} f_i(x_i-\overline{x})^2}{\sum f}}$

S = $\sqrt{\frac{(-0.002\times3)+(0.005\times(0.00\times6)}{14}}$

Therefore, the group data of the result of radiation records is

S = $\sqrt{0.0002857} = 0.01697 \approx 0.017\ mR/hr$

DISCUSSION OF RESULTS

As shown in table 1 the data was recorded with in three days in the refuse dumpsites. Dumpsites workers were met working on the refuse most of the time and within the spacing, different categories of waste was always brought in to the site. Therefore, from the chart above, the least value recorded to be 0.0l4mR/hr and the highest value was recorded to be 0.0l8mR/hr respectfully. It is true that there is indiscriminate disposal of refuse composed of different categories of waste from domestic waste, electronic waste and so on. The study has shown that these refuses are possible sources of radioactive materials.

The measurement of gamma radiation level in Wurogude dumpsite is higher than the other selected this might due to the fact that it is the oldest and largest among the selected dumpsites. The mean average radiation obtained values in all the dumpsites are higher than the normal background of 0.015mR/hr. The results of statistical analysis showed that there is significant difference between the obtained and computed results and their standards. These reported values may indicate no immediate hearth hazards, but may cause long-term health hazards to the dumpsite ‘workers and immediate residents of the host communities due to increase in longer periods of operations.

CONCLUSION

The three primordial radionuclides have been detected and measured in five different locations of refuse dump sites in Mubi north metropolis area of Adamawa state Nigeria. Despite the fact that all levels of ionizing radiation are hazardous to human health (Imtiaz et al. 2005, P. 169-174) the exposure level of the

emitted radiation on the selected dumpsite in Mubi north is high compared with Nigeria and World average which is 0.015mR/hr. For now, there is no system that was met at the study area for checking the type of refuse brought to the dumpsites. But this is a note of caution especially to the refuse dumpsite workers and scavengers. In all the refuse dumpsites, the reading taken slightly exceeded the standard background ionizing radiation dose of 0.015mR/hr by few factors. It could be necessary to suggest that there should be a shift system by the staff because of the amount of radiation absorbed depends on the time spent in the area, distance or closeness to the source of radiation and shielding. Therefore;

i) Refuse dumpsite workers should be provided with TLD badges, film, badges or EPD badges (personal dosimeters) to monitor the radiation dose absorbed by them.

ii) Waste material should be adequately checked at the, collation point.

iii) Dumpsite workers should operate shift system if they do not do that.

iv) There should be a regular measurement of background ionizing radiation levels in these Locations.

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