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Monitoring of Background Radiation in Selected Schools in Ota, Ogun State Nigeria by Direct Measurement of Terrestrial Radiation Dose Rate

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Abstract. Terrestrial radiations are natural types from radionuclides found in rocks, building materials and soils in an environment. Monitoring of background radiation energy levels in selected school in Ota, Ogun State Nigeria by direct measurement of terrestrial radiation dose rate was done. The mean dose rate ranged from 35.4 to 62.34 nGyh⁻¹. The measured mean values are within world average recommended limits of 59 nGyh⁻¹ except for study location SC7 with mean dose rate value of 62.34 nGyh⁻¹. On the over all, it can be concluded that the concentration of NORM (naturally occurring radioactive materials) and radiation dose rate in an environment is at safe level. Further environmental radiation assessment is recommended to ascertain the possible sources of background radiation dose rate and exposure, beside terrestrial radiation sources.

Keywords: Dose Rate, Terrestrial Radiation, Background Radiation Monitoring, Ota.

1. Introduction

Terrestrial radiations are natural types from radionuclides found in rocks, building materials and soils in an environment. Natural radioactivity requires concentration monitoring for sustainable health and environmental safety for general public. Radiation energy from naturally occurring radionuclides in the immediate environment contributes greatly to the background radiation level of that environment. Naturally, occurring radioactive materials (NORMs) are constituents of the earth crust; they continuously emit ionizing radiation as natural cause from the disintegrations of the radioactive materials. The geological formation of an area, makeup the earth crust, determines the radionuclide concentration that influences the background radiation level of the area. Research findings have it that radiation dose from NORMs makeup over 85% of the total dose that gets to man and 15% comes from artificial sources [1, 2, 3, 4]. Many individual has little or no reason to be exposed to manmade radiation, thus natural background radiation remains their total exposure. Natural background radiations are subdivided into cosmic radiation, radon inhalation, internal exposure and terrestrial external radiation [5, 6]. Of concern in this study is the monitoring of background radiation concentration levels in selected school by direct measurement of terrestrial radiation dose rate and radionuclide heads such as Thorium-232, Uranium-238 and Potassium-40. The environmental rocks and soils in an area naturally emits gamma radiation from the series Thorium-232, and Uranium-238 and none series Potassium-40. The emitted radiation gets to the general public both outdoor and indoor in an environment. It is therefore essential to measure terrestrial background radiation for assessment of exposure level to the public. Usikalu et al, 2018, worked on background radiation monitoring in industrial area of Ota town, the mean dose rate of the finding is presented in figure 1, the study concluded that the industrial areas of Ota environ is safe for dwellers [5].



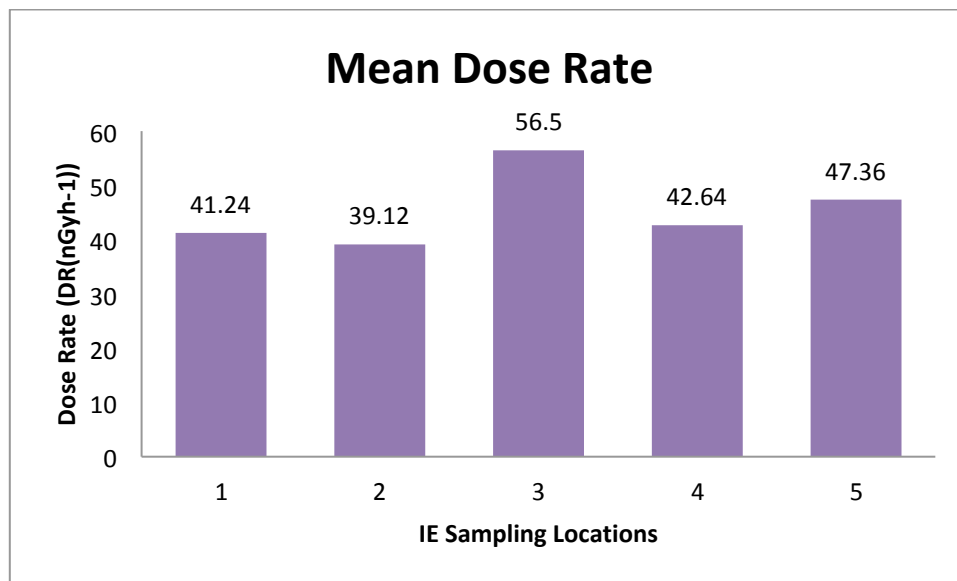


Figure 1. Mean dose rate for IE sampling locations [5]

2. Material and Method

The study area is Ota, a town in Ogun State, Nigeria with coordinates 07°57'N 04°47'E, it is the capital town of the Ado-Odo Local Government Area. There are many private and government (public) owned schools in Ota. Ten (10) out of the schools that are located along Idiroko- Owode road Ota were selected as shown in the figure 2, both private and public schools alike. A total of ten (10) schools were monitored for terrestrial background radiation assessment using RS-230 BGO Super-SPEC Handheld Gamma-Ray Spectrometer. The direct measurement of background radiation dose rates DR (nGy/h⁻¹) were measured and reported as shown in table 1. RS-230 BGO device used was set on assay mode to obtain the dose rate concentrations at sampling time of 90 seconds. Sample locations ID are SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8, SC9 and SC10 for the 10 selected schools. Five (5) sampling points were taken for each sample location and the mean dose rate was obtained and used for assessment. The RS-230 BGO was held one (1) meter above the ground level during active sampling.



Figure 2. Map of Study Area

3. Results and Discussion

The terrestrial background radiation dose rate DR (nGyh^{-1}) of 10 selected schools in Ota was measured and the obtained results are presented in table 1. The plot of the mean dose rate for sample SC1 to SC10 is shown in figure 3 for better mean dose rate comparison of the different sample locations. The obtained mean dose rate ranges from 35.4 to 62.34 nGyh^{-1} . Sample location SC7 recorded the highest mean dose rate value of 62.34 nGyh^{-1} while the least value of 35.4 nGyh^{-1} was recorded in location SC2. The respective mean dose rate for locations SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8, SC9 and SC10 are 49.44, 35.40, 52.10, 45.86, 51.90, 38.90, 62.34, 44.76, 58.04 and 39.48 nGyh^{-1} . Dose rate from terrestrial background radiation is usually assessed with the international unit of nanoSieverts per hour (nSvh^{-1}) for ease of comparison with world standards. Basically, 1 Gray (1 Gy) is equal to 1 Sievert (1 Sv) for gamma radiation, hence 1nGyh^{-1} will equal 1nSvh^{-1} . The US EPA report of 2017 presented dose rate limit for terrestrial radiation (background radiation from rocks, building materials and soils in an environment) to be less than 6 to more than 83 nSvh^{-1} in comparison with other possible exposure units such as milliRoentgen/hour (mRh^{-1}) for monitoring stations and this is comparable to world mean dose rate limit of 59 nGyh^{-1} [8]. A comparison of the obtained results with the world mean value limit for dose rate (DR) shows that all the obtained dose rate from all study is well within set limit except location SC7 that went above limit with the value by 3.34 nGyh^{-1} . A closer look at constituent dose rate readings that gave the mean value of 62.34 nGyh^{-1} for SC7, it was observed that there was an offshoot value of 75 nGyh^{-1} . This high offshoot value influenced the high mean dose rate obtained for location SC7. A comparison of the current work with the world standard and previous study in industrial area of Ota, as shown in figure 4, it can be seen also that SC7 went above the world standard. Man made factor or experimental error could be attributed to the value offshoot, but none the less, a further assessment is recommend for location SC7.

Table 1. Measured Terrestrial Background Radiation for Assessment of Public Exposure Radiation

Sample ID	DR (nGyh ⁻¹)					Mean
SC1	47.1	47.6	53.9	51.4	47.2	49.44
SC2	36.1	31.9	33.8	33.9	41.3	35.40
SC3	55.9	41.1	66.3	50.3	46.9	52.10
SC4	49.3	39.7	44.7	45.7	49.9	45.86
SC5	55.0	52.1	52.4	60.0	40.0	51.90
SC6	49.0	39.0	31.1	38.2	37.2	38.90
SC7	58.3	61.6	56.5	60.0	75.3	62.34
SC8	45.1	48.7	48.1	42.9	39.0	44.76
SC9	60.3	65.1	53.4	54.9	56.5	58.04
SC10	46.9	39.3	34.0	38.9	38.3	39.48

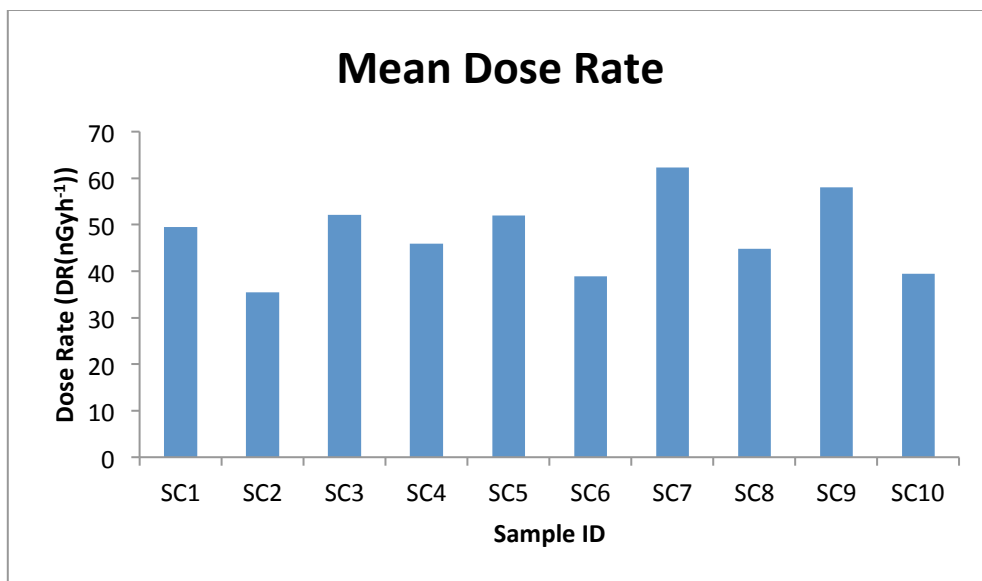


Figure 3. Mean Dose Rate for sample SC1 to SC10

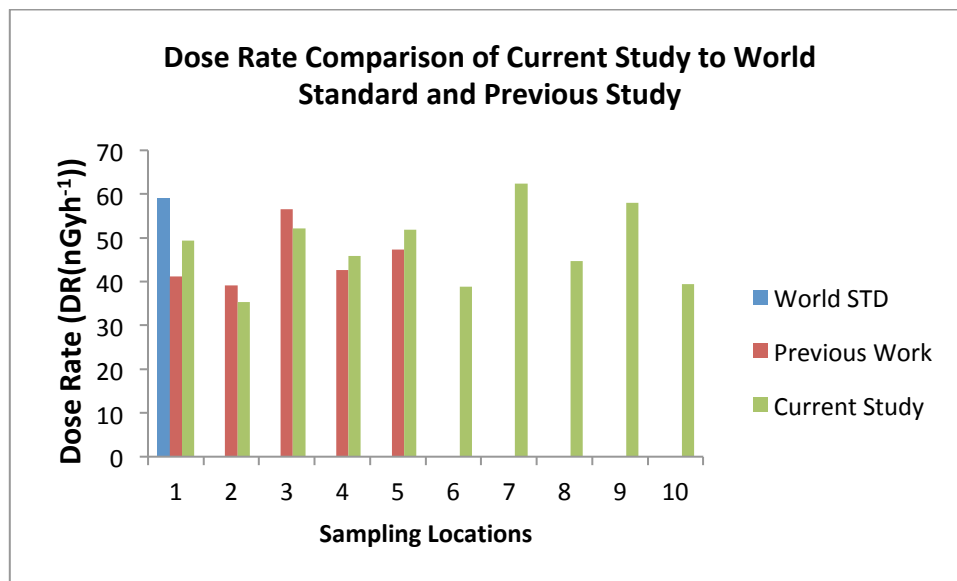


Figure 4. Comparison of Current study with World Standard and Previous Study

4. Conclusion

The dose rate of 10 selected schools in Ota environ were measured using RS-230 Super Spec gamma ray spectrometer. The measured mean values are within world average recommended limits of 59 nGyh⁻¹ except for study location SC7 with mean dose rate value of 62.34 nGyh⁻¹. On the over all, it can be concluded that the concentration of NORM (naturally occurring radioactive materials) and radiation dose rate in an environment is at safe level.

5. Recommendation

For study location SC7, a further environmental radiation assessment is recommended to ascertain the possible sources of background radiation dose rate and exposure, apart from the terrestrial radiation sources.

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