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Investigation of Natural Background Radiation of University Ofibadan

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ABSTRACT

This study was conducted inside university of Ibadan to investigate the natural background radiation of 100 selected points located within this area of study. The study was carried out with the use of standardized RadEye survey meter and the readings obtained were processed using Microsoft excel.

The processed results were analyzed through the mean and standard deviation of the measured and processed data and a pictorial diagram was displayed to indicate the trend of the natural background radiation of the chosen points within the study area.

The least value of the natural background radiation obtained from the varying trends is less than the no alarming effect value proposed by International Commission of Radiological protection and thus making its effect insignificant to the lives and properties within the study area.

1.0 INTRODUCTION

Radiation is the energy travelling in space. Radiation is present everywhere on earth surface. Consequently, man is continuously irradiated. There are two types of radiation, namely ionizing and non-ionizing radiation. The basic difference between ionizing and non-ionizing in the environment is that ionizing possesses sufficient energy to cause ionization[1]. In water of which cell are largely composed of, ionization can lead to molecular changes and formation of chemical species of types which are damaging to the chromosome material.

Ionizing radiation injury is dependent on a number of factors including: The nature, energy, dose, time of exposure, homogeneity of dose and shielding. When the dose and the dose rate are within the accepted levels, the effect of radiation is insignificant and most time no effect is noticed, although the effect of low level radiation is yet to be completely understood [2]. Human body is permanently irradiated from two ionizing radiation sources: External radiation sources which are either natural (embedded in the soil) or artificial (improperly shielded reactor)and both of equal risk to man. Inside the body, the 40K is by its nature present throughout human life. In the case of careless ingestion or inhalation, other radionuclides (such as radon in air) enter inside the body, the body becomes internally

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contaminated[3]. The level of the natural radioactivity in the soil and in the surrounding environment as well as the associated external exposure due to the gamma radiation depends primarily on the geological formations and geographical conditions of the region [4]. And these geological formations and geographical conditions dictate to a good degree the radionuclide contained in the soil and rocks in there. Soils contain small quantities of radioactive elements along with their progenies. The main sources of the external gamma radiation are from primordial radionuclides. Primordial radionuclides are present in the earth crust as a result of magma formation and intrusion in the earth crust [5]. These primordial radionuclides disintegrate spontaneously into different daughter nuclides in order to achieve stable forms. However, these radionuclides contribute to the average public radiation exposure. Other sources of radiation exposure come from energetic cosmic rays of extra-terrestrial origin. Over 98% of the public exposures to radiation come from natural radionuclides such as 40K, 238U, and 232Th and progenies [6]

This paper presents the background radiation level and gamma radiation absorbed dose rate that students, staff and members of general public within the campus of University of Ibadan, Ibadan are exposed to.

2.0 LOCATION OF STUDY AND ITS GEOLOGY

The area has certain flat surface with several inclined regions, thus the topography of the study area is generally alternatingly high and low altitude. Regions of high elevation (220m and above are) situated at the south central of the study area, places at these elevated regions include faculty of Technology, ObafemiAwolowo Hall, Anthropology, Mathematics and statistics department.

In conclusion, the study area is partially lowland, more so, undulating .The highest point in the area is about 223m above sea level and it is located at Awo stadium, adjacent barth road.

The basement complex rocks in university of Ibadan are commonly the metamorphic type of Precambrian age, but with a few intrusion of granites and porphyries of Jurassic age.

These rocks can be grouped into major and minor types. The major types are quantizites of the metasedimentary series and the migmatites complex comprising banded gneisses,augen gneiss and migmatites. The minor rock types include pegmatites, quartz,aplite,diorites,amphibolites and xenoliths [7].

Over 75% of rocks in university of Ibadan are banded gneisses. Granite gneisses and

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quartzites share the remaining 25% of the area in almost equal halves.

3.0 MATERIALS AND METHODS

Measurements were taken uniformly around the campus of university of Ibadan with the use of survey meter.

A total number of hundred 100 points were chosen for the survey work in the university of Ibadan.

All the locations were linked by roads which make them easily accessible. The distance between two points is approximated at 220m.

The total area of the campus is 4.86 x 10^6 mm^2, three major landform units dominate the scenery area of the campus. These are hills, the plains and the river valleys.

From the geological formation of university of Ibadan, we have three major rock types present in each location. The table below shows the rock type present in each location.

Table 1: Geological Formation of the Surveyed Area within University of Ibadan

Locations	Rock type
Faculty of science	Banded gneiss
Faculty of Social Sciences	Banded gneiss
Faculty of Agriculture	Augen gneiss
Veterinary Medicine	Augen gneiss
Amina Way/Bini Road	Augen gneiss with quartz intrusion
Faculty of Technology	Quartzite
Cbt.Awo Hall	Quartzite
Idia,Tafawa Balewa/Indy Hall	Quartzite
Zik,Kuti,Jaja Clinic/Admission	Quartzite
Tedder/Mellanby/Chapel/Mosque	Banded gneiss
S.U.B/Niser Park U.I/ poly junction	Banded gneiss Quartzite with intrusion
Postgraduate school	Augen gneiss
Abadina/diamond fm	Augen Gneiss
Niger road/ yc lodge	Quartzite with intrusion
Faculty of education	Banded gneiss
Faculty of law	Banded gneiss
Faculty of pharamarcy	Augen Gneiss
Keneth dike library	Banded gneiss
Faculty Of Arts	Banded gneiss

3.1 COUNTING METHOD

Radeye PRD is used for the survey as it is reliable, portable and efficient. It is a digital survey meter

that measures the strength and composition of radioactive sources.

The survey meter was taken to the locations as discussed in table 1, raised 1m away from the mean ground level to detect the radioactive contribution to the natural background radiation in university of Ibadan.

The survey commenced inside university of Ibadan at the discussed locations on the 21st of Nov, 2013 at about 11:00am and lasted for about 8 hours.

3.2 CALIBRATION

The survey meter is standardized to measure the aforementioned quantity and it is done according to Secondary Standard Dosimetry Laboratory **SSDL.**

3.3 DEAD TIME

The dead time of a detector is defined as the minimum time interval that two consecutive counts must have in order to be recorded as two different events. The effect of having a dead time in a detector used to monitor counting rates is that the measured counting rates will be lower than the real ones. However, the real counting rates can be determined from the measured ones if the dead time of detector is known.

It is the time after each event during which the system is not able to record another event. The total dead time of a detection system is usually due to the contribution of the intrinsic dead time of the detector.

Table 2: survey locations

The intrinsic dead time of a detector is often used due to its physical characteristics, for example, a spark chamber is dead until the potential between the plates recovers above a high enough value, in other cases, and the detector after a first event is still live and produces a signal for the successive event.

Dead times are relatively short but nevertheless significant being typically of the order of 200-400μs.As a result, the readings obtained with this detector are less than it should be.

The true reading can be obtained from the below equation:

$$T = \frac{A}{1-\beta A}$$

Where,

T is the true reading

A is the actual reading

β is the dead time

3.4 COVERAGE

A hundred points were chosen within the nineteen locations listed below and a survey was carried out at those points to measure their corresponding natural background radiations.

The surveyed locations are outlined below :-

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Locations	
Faculty of science	1
Faculty of Social Sciences	2
Faculty of Agriculture	3
Veterinary Medicine	4
Amina Way/Bini Road	5
Faculty of Technology	6
Cbt,Awo Hall	7
Idia,Tafawa Balewa/Indy Hall	8
Zik,Kuti,Jaja Clinic/Admission	9
Tedder/Mellanby/Chapel/Mosque	10
S.U.B/niser park	11
Postgraduate school	12
Abadina/diamond fm	13
Niger road/ vc lodge	14
Faculty of education	15
Faculty of law	16
Faculty of pharamarcy	17
Keneth dike	18
Faculty Of Arts	19

Chart Area

4.0 RESULTS AND DISCUSSION

Table 3: Background radiation readings of the Surveyed Area within university of Ibadan

S / N	POINT	ABSORBED DOSE (µSv/hr)
1	1	0.03
2	2	0.04
3	3	0.04
4	4	0.05
5	5	0.05
6	6	0.11
7	7	0.04
8	8	0.05
9	9	0.06
10	10	0.03
11	11	0.04
12	12	0.04
13	13	0.05
14	14	0.04
15	15	0.04
16	16	0.07

1	7	1	7	0	.	0	7
1	8	1	8	0	.	0	7
1	9	1	9	0	.	0	7
2	0	2	0	0	.	0	4
2	1	2	1	0	.	0	3
2	2	2	2	0	.	0	8
2	3	2	3	0	.	0	3
2	4	2	4	0	.	0	4
2	5	2	5	0	.	0	5
2	6	2	6	0	.	0	8
2	7	2	7	0	.	0	5
2	8	2	8	0	.	1	2
2	9	2	9	0	.	0	7
3	0	3	0	0	.	0	4
3	1	3	1	0	.	0	4
3	2	3	2	0	.	0	4
3	3	3	3	0	.	0	6
3	4	3	4	0	.	0	8
3	5	3	5	0	.	0	7
3	6	3	6	0	.	0	7
3	7	3	7	0	.	0	7
3	8	3	8	0	.	0	5
3	9	3	9	0	.	0	5
4	0	4	0	0	.	0	5
4	1	4	1	0	.	0	5
4	2	4	2	0	.	0	5
4	3	4	3	0	.	0	6
4	4	4	4	0	.	0	4
4	5	4	5	0	.	0	5
4	6	4	6	0	.	0	5
4	7	4	7	0	.	0	3
4	8	4	8	0	.	0	3
4	9	4	9	0	.	0	5
5	0	5	0	0	.	0	3
5	1	5	1	0	.	0	4
5	2	5	2	0	.	0	3
5	3	5	3	0	.	0	2
5	4	5	4	0	.	0	5
5	5	5	5	0	.	0	4
5	6	5	6	0	.	0	5
5	7	5	7	0	.	0	5
5	8	5	8	0	.	0	5

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5 9	5 9	0 . 0 5
6 0	6 0	0 . 0 8
6 1	6 1	0 . 0 4
6 2	6 2	0 . 0 4
6 3	6 3	0 . 0 4
6 4	6 4	0 . 0 4
6 5	6 5	0 . 0 5
6 6	6 6	0 . 0 7
6 7	6 7	0 . 0 5
6 8	6 8	0 . 0 5
6 9	6 9	0 . 0 5
7 0	7 0	0 . 0 3
7 1	7 1	0 . 0 3
7 2	7 2	0 . 0 5
7 3	7 3	0 . 0 5
7 4	7 4	0 . 0 4
7 5	7 5	0 . 0 5
7 6	7 6	0 . 0 5
7 7	7 7	0 . 0 5
7 8	7 8	0 . 0 5
7 9	7 9	0 . 0 7
8 0	8 0	0 . 0 6
8 1	8 1	0 . 0 4
8 2	8 2	0 . 0 3
8 3	8 3	0 . 0 4
8 4	8 4	0 . 0 5
8 5	8 5	0 . 0 5
8 6	8 6	0 . 0 6
8 7	8 7	0 . 0 7
8 8	8 8	0 . 0 6
8 9	8 9	0 . 0 6
9 0	9 0	0 . 0 3
9 1	9 1	0 . 0 4
9 2	9 2	0 . 0 3
9 3	9 3	0 . 0 5
9 4	9 4	0 . 0 3
9 5	9 5	0 . 0 5
9 6	9 6	0 . 0 5
9 7	9 7	0 . 0 5
9 8	9 8	0 . 0 6
9 8	9 9	0 . 0 6
1 0 0	1 0 0	0 . 0 6

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The mean and the standard deviation is obtained as follows

The mean absorbed dose of the campus is calculated by the formula below as

$$\bar{x} = \frac{\sum N}{n}$$

Where $\sum N = summation\ of\ all\ the\ absorbed\ dose$

n = is the total number of point

$\bar{x} = \frac{5.03}{100}$

$\bar{x}$= 0.0503µsv/hr

The standard deviation of the absorbed dose in university of Ibadan is calculated by the formula given below as ;-

Standard deviation = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

Standard deviation=$\sqrt{0.00026468036}$

Standard deviation= 0.016296 µsv/hr

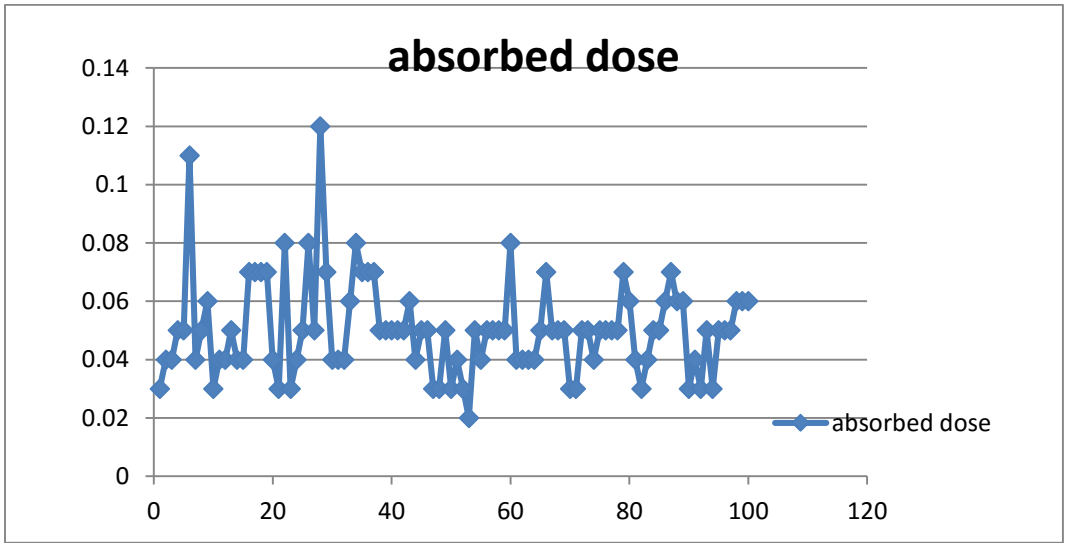

Fig 2: The Graph of Absorbed Dose (µSv/hr) against the Points

From the graph above we can deduce that with the minimum and maximum background radiation level

The minimum background radiation is $0.02\mu Sv/hr$ and it occurred at point 53 which corresponds to independent hall and the rock type present at this location is the quartzite.

The maximum background radiation which was recorded is 0.12µSv/hr and it occurred at veterinary pathology and the rock type present there is Augen gneiss

It was observed that the location having their background radiation readings far above the mean value($0.0503\mu sv/hr$) are all situated in the augen gneiss rock region while the locations with background radiation readings below the mean value are situated of the quartzite and the banded gneiss rock regions.

5.0 CONCLUSION

The precision of the result of this survey depends on the accuracy of the survey meter used and source distribution. To a great extent, the reliability of the survey meter used (RADEYE) can be ascertained as it was got from the National Institute of Radiation protection and research (NIRPR) for the purpose of this study.

The radiation level distribution of these natural radio-active elements varied from one location to another. The distribution also depends on the rock types in the location.

The International Commission of Radiological Protection (I.C.R.P) has considered it reasonable to set a public dose limit based on a risk level which appears to be regularly accepted by the public everyday life. The International Commission of Radiological Protection (I.C.R.P) has considered that a risk in the range of 10^{-16} to 10^{-5} per year would likely be acceptable to the individual member of the public. The International Commission of Radiological Protection (I.C.R.P) recommends an annual dose limit of an effective dose of 1mSv. The dose limit is summarized in the table below.

Table 4: Recommended Dose Limit by I.C.R.P

Applications	Occupational dose limit	Public dose limit
Effective dose	20mSv/year average over a defined period of 5years	1 mSv/year.
Annual Equivalent dose in the lens of the eye.	150 mSv	50 mSv
The skin	500 mSv	

We can therefore conclude that university of Ibadan is a contaminant free environment; this is because the highest the dose level (0.12 $\mu sv/hr$) which corresponds to the location veterinary pathology is lesser than the 1mSv effective dose limit set up by International Commission of Radiological Protection (I.C.R.P) and thus implies that university of Ibadan has a very low natural background radiation level.

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