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MEASUREMENT OF RADIATION DOSE LEVEL WITHIN QUEEN AMINA HALL, AHMADU BELLO UNIVERSITY, ZARIA

Nuraddeen Nasiru Garba*, Rabiun Nasiru, Muniba Sufiyan and Abdullahi Muhammad Vatsa

Department of Physics, Ahmadu Bello University, Zaria, Nigeria

*Corresponding author: nngarba@abu.edu.ng, +2348034298444

ABSTRACT

Measurement of background radiation is of great interest for it provides useful information in monitoring environmental radioactivity. The aim of the present study is to provide information and generate database on the natural background radiation dose levels of densely populated Queen Amina Hall, Ahmadu Bello University, Zaria. The radiation dose (outdoor and indoor dose rate) were measured at 29 rooms (Block 1- 4) and their compounds using RADOS survey meter held at 1m above the ground. The measured radiation dose ranged 0.13 nGyh⁻¹ to 0.43 nGyh⁻¹ and 0.54 nGyh⁻¹ to 1.72 nGyh⁻¹ for indoor and outdoor respectively. Some of the high values recorded could be attributed due to the contribution of cosmic radiation emanating from the atmosphere as well as the geological settings of the location as there is no any artificial contributing factor within the area. The annual effective doses within the study area was found to be 0.01 mSvy⁻¹ throughout which is quit below the world average value of 0.87 mSvy⁻¹ for natural sources.

Keywords: Radiation dose, Annual effective dose, RADOS meter, Queen Amina

INTRODUCTION

Natural radiation is the largest contributor of external dose to the world population and assessment of gamma radiation from natural sources is of particular importance in order to know the safety of the inhabitant from the radiation. Human beings are exposed to natural background radiation every day from the ground, building materials, air, water, the universe and even elements in their own bodies. There is no location on Earth that is free of natural radioactivity (Kurnaz, 2013). Gamma radiation emitted from primordial radioisotopes is one of the main external sources of radiation on earth (UNSCEAR, 1993, 2000).

Studies and survey of natural environmental radioactivity are of great importance and interest in health physics not only for many practical reasons but for more fundamental scientific reasons (Abd El-mageed *et al.*, 2011). Since natural radiation is the main source of human exposure, studies of the dose from this source and its effect on health improve the understanding of radiation damage and therefore, are of great value as a reference when standards and regulatory control actions on radiation protection are established (Abd El-mageed *et al.*, 2011; Garba, Ramli, Gabdo, &

Sanusi, 2013). This give rise to a strong need to measure the amount of radiation dose in the environment, to compare them with the standard limits set by ICRP. As such, the principal aim of this study is to provide a base line information and generate database on the natural background radiation dose levels of dense populated Queen Amina Hall, Ahmadu Bello University Zaria.

MATERIALS AND METHODS

The material used in this studies are radiation survey meter, RADOS, RDS 120 and Global Position System (GPS), Garmin 76.

The Study area

The area studied is Queen Amina hall located at Ahmadu Bello University Zaria main campus. It is located within 11.1512⁰ N and 7.6546⁰ E and it consist of nine blocks with a total number of 468 rooms. The buildings were four story with similar masonry materials.

Measurements of Radiation dose Level

The radiation dose levels within the study area was measured using a portable radiation survey meter (RADOS, RDS 120).

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The measurement were carried out in the selected rooms of the hostel by holding the detector, one meter (1m) above the ground level. At each point, measurement was taken three times and the mean value of each point was recorded. The location of each point locations recorded with a global positioning system (GPS).

Annual Effective Dose

The annual effective dose to the population due to the natural radionuclides in the soil was determined by summing up the outdoor and indoor annual effective doses to the population obtained using Equations (1) and (2) with the dose coefficient (0.7 Sv Gy^{-1}) and occupancy factor (0.2) for outdoors and (0.8) for indoors (UNSCEAR, 2000).

$$IAE = D_{in} \times T \times OF \times Q \tag{1}$$

$$OAE = D_{out} \times T \times OF \times Q \tag{2}$$

where D_{in} and D_{out} are the mean absorbed dose in air indoor and outdoor, T is the time converter from hours to year, OF, the occupancy factor, that is the fraction of time spent indoor and outdoor which are 0.8 and 0.2 respectively, Q is the conversion factor of 0.7 SvGy , which

converts the absorbed dose rate in air to human effective dose received (Khandaker *et al.*, 2019; UNSCEAR, 2000). Then the summation of indoor and outdoor dose rate was taken which gives the total annual effective dose.

$$TAE (\text{mSvy}^{-1}) = OAE + IAE \tag{3}$$

where: OAE = Outdoor Annual Effective dose, IAE = Indoor Annual Effective dose, TAE = Total Annual Effective dose and D = Dose rate (μSvh^{-1}).

**RESULTS AND DISCUSSION
Radiation Dose Level**

The results of the measured radiation dose levels (outdoor and indoor) within the study area are presented in Table 1- 5.

The average radiation dose level measured in Block 1 was found to range from 0.13 to 0.38 nGyh^{-1} for indoor and 0.54 to 1.52 nGyh^{-1} , for outdoor with room 13 having the highest values for both indoor and outdoor radiation dose levels with respective values of 0.38 and 1.52 nGyh^{-1} (Table 1) which were below the world mean value of 59 and 84 nGyh^{-1} for outdoor and indoor respectively as reported by UNSCEAR (2000).

Table 1: Radiation Dose Level in Block 1

S/N	Location	Mean Dose Rate (mSv/hr)		
		Indoor	Outdoor	Total
1	Room 2	0.36	1.42	1.78
2	Room 7	0.13	0.54	0.67
3	Room 13	0.38	1.52	1.90
4	Room 22	0.28	1.13	1.41
5	Room 31	0.36	1.42	1.78
6	Room 37	0.30	1.23	1.53

However, in block 2, the average measured radiation dose level was found to range from 0.28 to 0.36 nGyh^{-1} for indoor and 1.13 to 1.42 nGyh^{-1} , for outdoor with room 37 having the highest values for both indoor and outdoor radiation dose levels with respective values of 0.36 and 1.42 nGyh^{-1} (Table 2) which were below the world mean value of 59 and 84 nGyh^{-1} for outdoor and indoor respectively as reported by UNSCEAR (2000).

Table 2: Radiation Dose Level in Block 2

S/N	Location	Mean Dose Rate (nGyh^{-1})		
		Indoor	Outdoor	Total
1	Room 5	0.30	1.28	1.60
2	Room 8	0.29	1.18	1.47
3	Room 20	0.28	1.13	1.41
4	Room 37	0.36	1.42	1.78
5	Room 47	0.30	1.23	1.53
6	Room 51	0.32	1.28	1.60

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Also, for block 3, the average measured radiation dose level was found to range from 0.28 to 0.36 nGyh⁻¹ for indoor and 1.13 to 1.42 nGyh⁻¹ for outdoor (Table 3) with room 12 and 20 having the highest values for indoor and

outdoor radiation dose levels with respective values of 0.28 and 1.42 nGyh⁻¹ which were below the world mean value of 59 and 84 nGyh⁻¹ for outdoor and indoor respectively as reported by UNSCEAR (2000).

Table 3: Radiation Dose Level in Block 3

S/N	Location	Mean Dose Rate (nGyh ⁻¹)		
		Indoor	Outdoor	Total
1	Room 1	0.30	1.28	1.90
2	Room 5	0.29	1.18	0.67
3	Room 12	0.28	1.13	1.41
4	Room 20	0.36	1.42	1.47
5	Room 37	0.30	1.23	1.60
6	Room 51	0.32	1.28	1.90

The average radiation dose level in Block 4 was found to range from 0.13 to 0.36 nGyh⁻¹ and 0.54 to 1.42 nGyh⁻¹ for indoor and outdoor respectively as shown in Table 4, with room 35 and 23 having the highest values for indoor and

outdoor radiation dose levels with respective values of 0.28 and 1.42 nGyh⁻¹ which were below the world mean value of 59 and 84 nGyh⁻¹ for outdoor and indoor respectively as reported by UNSCEAR (2000).

Table 4: Radiation Dose Level in Block 4

S/N	Location	Mean Dose Rate (nGyh ⁻¹)		
		Indoor	Outdoor	Total
1	Room 5	0.28	1.13	1.41
2	Room 11	0.29	1.18	1.47
3	Room 14	0.30	1.23	1.53
4	Room 23	0.36	1.42	1.78
5	Room 35	0.13	0.54	0.67
6	Room 40	0.32	1.28	1.60

The radiation dose level in other places (cafeteria, laundry, common room, security office, admin room and the compound) within

the study area were also assessed and presented in Table 5 in order to compare their values with that measured in rooms.

Table 5: Radiation Dose Level in Other Places

S/N	Location	Mean Dose Rate (nGyh ⁻¹)		
		Indoor	Outdoor	Total
1	Cafeteria	0.32	1.28	1.60
2	Laundry	0.32	1.28	1.60
3	Common room	0.28	1.13	1.41
4	Security office	0.28	1.13	1.41
5	Admin block	0.32	1.28	1.60
6	Compound	0.43	1.72	2.15

The radiation dose levels was found to range from 0.28 to 0.43 nGyh⁻¹ and 1.13 to 1.72 nGyh⁻¹ for indoor and outdoor respectively as shown in Table 5, with compound of the hostel having the highest values for both indoor and outdoor radiation dose levels with respective values of 0.43 and 1.72 nGyh⁻¹ which were below the

world mean value of 59 and 84 nGyh⁻¹ for outdoor and indoor respectively as reported by UNSCEAR (2000). In general, it was observed that the compound of block 4 was having the highest value of the measured radiation dose levels.

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The authors have the opinion that the higher radiation doses observed in the area may be due to natural sources such as cosmic radiation from the atmosphere and geological setup of the location as there is no any contributing artificial factor. Also, the result is very much in agreement with that of other similar studies conducted in higher education of learning within the country as reported in (Akeju, Aboyeji, Salau, & Ojo, 2016; Chad- Umoren & Briggs- Kamara, 2010; Kolo, Baba-Kutigi, Olarinoye, & Sharifat, 2012; Okoye & Awwiri, 2013; Oladipupo & Yabagi, 2015; Olarinoye, Sharifat, Baba-Kutigi, Kolo, & Aladeniyi, 2010; Ushie, Pekene, Egeshi, & Ohakwere-Eze, 2015).

Annual Effective Dose (AED)

The total annual effective dose to the population within the study area was calculated using Equation 3 was found to range within 0.01 mSv⁻¹ throughout the study area irrespective of the location that is indoor or outdoor and is by

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- far below the world average value of 0.87 mSv⁻¹ set by UNSCEAR (2000) for natural sources. This is an evident from the results obtained for the radiation dose levels which were used for the computation. Thus, the area can be regarded/classified as safe for living as it doesn't pose any significant radiation dose to the population as specified by different regulatory bodies such as UNSCEAR, ICRP and NNRA.
- ### CONCLUSION
- Based on the measured radiation doses within the study area as well as the calculated associated radiation risk parameter (annual effective dose), it can be concluded that the famous Queen Amina Hall, Ahmadu Bello University Zaria is within safe radiation level as it doesn't possess any elevated radiation level which will subject its occupant to danger/risk associated with exposure to radiation.
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