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A survey of environmental radioactivity level in laboratories of the town Campus University, Uyo Niger Delta region

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ABSTRACT

The UNSCEAR [1] observed that there could be some exposure at work which would require regulatory control but is not really considered. This study was, then, set up to evaluate the annual effective dose equivalent of 25 Laboratories in Town Campus of University of Uyo, Nigeria and to determine if the evaluated dose levels could lead to any radiological health effect in the workers, and also to determine if the laboratories require regulatory control. The radiation exposure at the laboratories measured using Inspector alert surveying meter were converted to effective dose and compared with the public and occupational values. From the results, the effective dose equivalent were moderately low varying from 0.128±0.041mSv/yr to 0.309±0.049mSv/yr with mean value of 0.2294±0.04 65 except in pharmaceutical/Medicinal Chemistry Laboratory store room (SA_{25}) where higher value of 1.015±0.09mS/yr was recorded. The evaluated effecti ve dose values in the laboratories were below public and occupational exposure safe limits and may not necessarily result in any radiological health hazard.

Keywords: effective dose, Occupational exposure, Laboratories, University of Uyo, health hazard.

INTRODUCTION

The vast global interest in the study and survey of naturally occurring radiation and environmental radioactivity had been essentially based on the importance of using the results from such studies for the assessment of public radiation exposure rates and the performance of epidemiological studies, as well as reference radiometric data relevant in studying the possible changes in environmental radioactivity due to nuclear, industrial and other human technology-related activities[1]. Again, it has been established that out of the total radiation dose that the world population receives, about 96.1% is from natural sources and the remainder is from human-made sources[3].

Owing to the health risks associated with the exposure to indoor radiation, many governmental and international bodies such as the International Commission on Radiological Protection (ICRP), the World Health Organization (WHO), etc. have adopted strong measures aimed at minimizing such exposures. This is imperative because the most significant exposure as regards the radiation health burden is due to the isotopes of radon (^{222}Ra and ^{224}Ra) and are the members of the decay series of ^{238}U and ^{232}Th, (^{226}Ra and ^{224}Ra) and are members of the decay series of ^{238}U and ^{238Th}, respectively. Radon and its short-lived daughters are alpha emitters. They consequently become a major source of internal exposure of the respiratory tracts when inhaled [3,4,5], hence the call for the measurement and survey of environmental radioactivity levels [6,7,8].

In Nigeria there is concerted effort towards determining the radionuclide concentration levels in the environment, different raw mineral and building materials [9,10,11,12,] industrial wastes and by-products from some industries [13,14,15,16,17,18,19,20,21,22, and 23].

This present paper was designed to add to and enhance the existing information on the survey of environmental radioactivity level in Nigeria with particular interest in Town Campus University, Uyo in Niger Delta Region. Presently, there is no data existing on the survey of environmental radioactivity level in Town Campus University in Uyo.

The knowledge of radiation level in the environment is imperative; this study is therefore expected to yield data that will provide information that may be used to assess the health effects on the population in the study area. The objectives of the present study are to: (i) determine the level of radioactivity in all the Laboratories in the University Campus Uyo (ii) evaluate radiation dose equivalent from the count rates for different locations in the University; and (iii) determine the possible dose impact of the research operations on the Laboratory workers, students, lecturers and other member of the public.

Location of the Study Area

S/N	Locations	Sample Code
1	Physics Laboratory I	SA_1
2	Physics Laboratory II	SA_2
3	Physics workshop	SA_3
4	Physics store	SA_4
5	Chemistry Laboratory I	SA_5
6	Chemistry Laboratory II	SA_6
7	Chemistry Laboratory III	SA_7
8	Zoology Laboratory I	SA_8
9	Zoology Laboratory II	SA_9
10	Microbiology Laboratory I	SA_{10}
11	Microbiology Laboratory (PG)	SA_{11}
12	Botany & Ecological Laboratory I	SA_{12}
13	Botany & Ecological Laboratory II	SA_{13}
14	Pharmaceutical/Medicinal Chemistry Lab (PG)	SA_{14}
15	Pharmaceutical/Medicinal Chemistry Lab I	SA_{15}
16	Pharmaceutical/Medicinal Chemistry Lab II	SA_{16}
17	Pharmaceutical/Medicinal Chemistry Lab (Instrument Rm)	SA_{17}
18	Pharmacology and Toxicology (Animal House)	SA_{18}
19	Pharmacognosy Laboratory I	SA_{19}
20	Central Research Laboratory	SA_{20}
21	Food Science and Technology Laboratory	SA_{21}
22	Zoology Store	SA_{22}
23	Central Research Lab (Instrument room)	SA_{23}
24	Pharmacognosy Laboratory II	SA_{24}
25	Pharmaceutical/Medicinal Chem Lab. (Store Room)	SA_{25}

MATERIALS AND METHODS

A typical portable Inspector Alert ™ Nuclear Radiation Monitor was used to detect and measure the radiation equivalent dose. The survey meter, model GLR61-6AM6-9V, serial No. 33333. Quality 1, The Nuclear Radiation Monitor is made in USA by International Medcom. The Inspector Alert™ Handheld Nuclear Radiation Monitor improves safety in laboratories and in the field through quick analysis and determination of radiation levels. The handheld monitor measures alpha, beta, gamma and x-radiation. Its safety-first calibration feature can eliminate exposure for personnel. The Inspector Alert quickly notifies first responders to the presence of harmful levels of nuclear radiation. Easy to read digital display shows a wide variety of readings: mR/hr, CPM, CPS, or µSv/hr. But in this study, the measurement was expressed in micro Sievert per hour ($\mu Svhr^{-1}$). The survey meter is run by one 9V battery.

Experimental procedure

At each laboratory, the survey meter was held about 0.03m away from laboratory instruments/ equipment/chemicals/reagents. Since radioactivity measurement or process is statistical 100 readings were taken on

each laboratory, average and error of the readings were obtained. The equivalent dose in $\mu Svhr^{-1}$ from the survey meter was converted to the annual dose rate in $mSvyr^{-1}$ for each of the location using the relations by [24]:

$$HT_C = \frac{\delta \times \mu \times 24 \times 365}{1000} \quad (1)$$

$$\delta = \frac{HT}{Q} \quad (2)$$

$$\overline{X} = \frac{\sum HT_C F}{\sum F} \quad (3)$$

$$SE = \sqrt{\frac{\sum F(HT_C - \overline{X})^2}{N}} \quad (5)$$

Where HT = Equivalent dose in $\mu Svhr^{-1}$
HT_C = Equivalent dose in $mSvyr^{-1}$
δ = Absorbed dose in $Gyhr^{-1}$
μ = Outdoor occupancy factor
Q = Quality factor = 1
SE =Standard error

RESULTS AND DISCUSSION

Owing to the differences in instruments, equipment, chemicals and reagents in various laboratories under study, their radiation levels differ significantly from laboratory and from one place to another. The radiation parameters [effective dose equivalent ($mSvyr^{-1}$)] with standard deviation are presented in Table 1 and the distribution in Fig. I.

TABLE 1: Equivalent dose (HT) and statistical analysis for environmental radioactivity survey of Laboratories in University Campus, Uyo

S/N	Sample Code	$\mu Svhr^{-1}$	$mSvyr^{-1}$	SE	Dose equivalent
1	SA_1	0.101	0.177	0.0017	0.177
2	SA_2	0.111	0.194	0.0210	0.194
3	SA_3	0.124	0.218	0.0011	0.218
4	SA_4	0.089	0.156	0.0035	0.156
5	SA_5	0.092	0.161	0.0035	0.161
6	SA_6	0.073	0.128	0.0023	0.128
7	SA_7	0.107	0.188	0.0032	0.188
8	SA_8	0.136	0.239	0.0024	0.239
9	SA_9	0.093	0.164	0.0029	0.164
10	SA_{10}	0.089	0.156	0.0035	0.156
11	SA_{11}	0.097	0.169	0.0013	0.169
12	SA_{12}	0.084	0.147	0.0029	0.147
13	SA_{13}	0.095	0.168	0.0014	0.168
14	SA_{14}	0.176	0.309	0.0350	0.309
15	SA_{15}	0.139	0.243	0.0350	0.243
16	SA_{16}	0.161	0.282	0.0020	0.282
17	SA_{17}	0.0891	0.158	0.0021	0.158
18	SA_{18}	0.0950	0.167	0.0029	0.061
19	SA_{19}	0.156	0.274	0.0030	0.274
20	SA_{20}	0.095	0.168	0.0014	0.168
21	SA_{21}	0.096	0.169	0.0017	0.169
22	SA_{22}	0.117	0.204	0.0029	0.204
23	SA_{23}	0.136	0.238	0.0013	0.243
24	SA_{24}	0.139	0.243	0.0042	0.243
25	SA_{25}	0.580	1.015	0.0201	1.015
			0.2294		

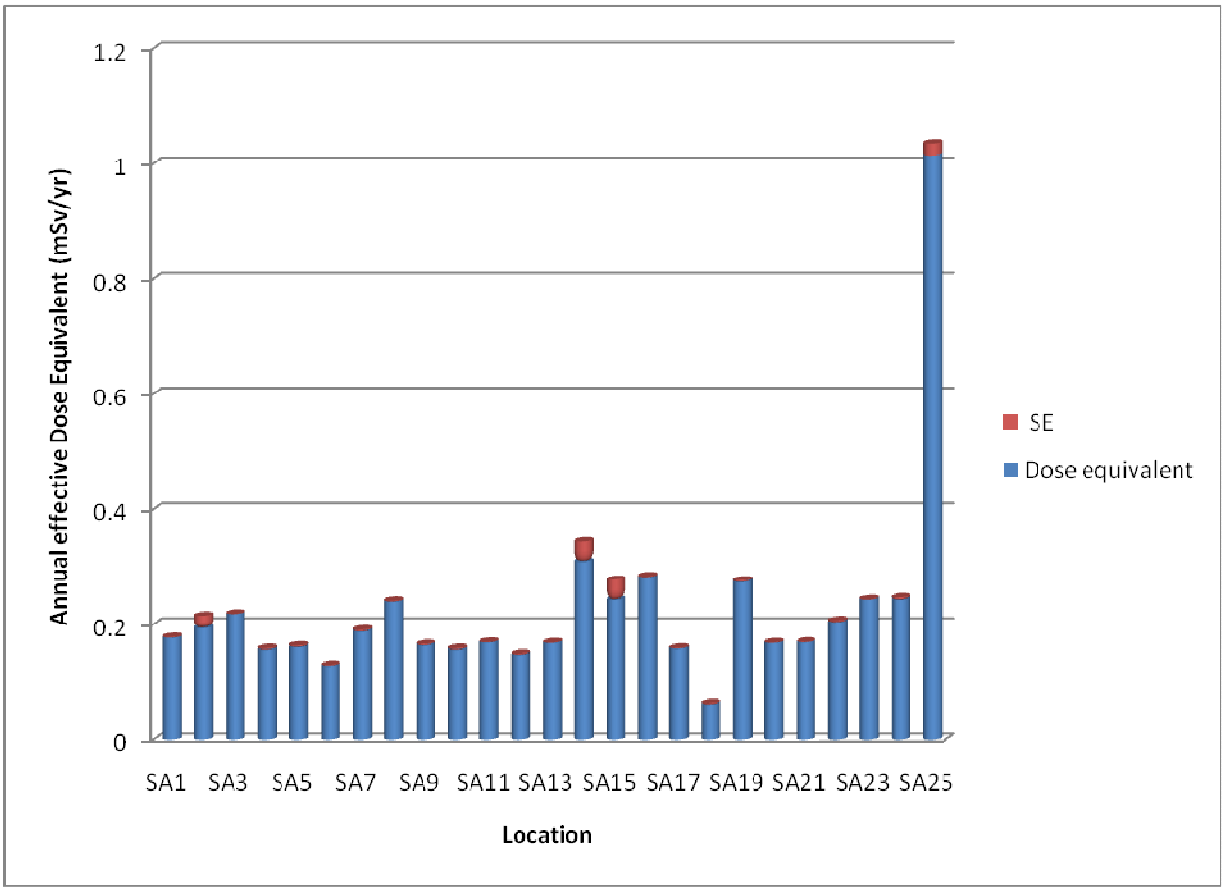

Fig. 1: Distribution of Annual effective dose equivalent with the standard deviation

From the results obtained (Table I) the maximum dose equivalent of 1.015±0.091mSvyr^{-1} was in Medicinal Chemistry (SA_{25}) with minimum dose equivalent of 0.128±0.041mSv/yr was in Central Research Lab (SA_{23}). The average effective dose equivalent of 0.23±0.047mSv/yr was obtained from 25 locations in the university campus. These values were low when compared with the effective dose equivalent (0.745±0.085mSv/yr) at the upland campus of University of Port-Harcourt[25] and the [26]. Therefore, there is need to protect the environment for adequate health and well being of the people, as well as to conserve and use sustainably the environment and natural resources for the benefit of present and future generations.

CONCLUSION

Based on the findings from this paper, the following conclusion can be drawn as regards the characteristics of radioactivity levels in Town Campus of University.

- A radiation level above permissible limits was observed on Pharmaceutical and Chemistry Laboratory (store room) within the study area. Within the store room, equivalent dose of 1.05±0.091mSv/yr was obtained. This value was higher than the prescribed safe limits, since the acceptable dose equivalent for the public is 1mSv.yr^{-1} or 20mSv.yr^{-1} for radiation workers (ICRP, 1991).
- Again, the result indicated 24 out of 25 locations of the study area with low effective equivalent dose when compared with the international safe limit of ICRP, 1991.

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