

BACKGROUND GAMMA RADIATION LEVELS IN THE NIGERIAN ENVIRONMENT

By

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ABSTRACT

There are few available data on radiation levels in the Nigerian environment. Pilot measurements of absorbed dose levels of radiation in several towns in Nigeria were made.

Although higher elevated and mine areas showed higher absorbed doses, the levels encountered were within normal limits when compared with data in literature but well below those reported in higher radiation areas of the world.

This preliminary study has assumed added relevance because, the Chernobyl, recent nuclear accidents and the dumping of 'radioactive' wastes on Nigeria coastlines have shown that radiation does not observe national or regional boundaries. The need for researchers in this field to obtain national background effective dose for Nigeria is emphasized.

INTRODUCTION

In many countries of the world, there have been concerted efforts made to estimate the levels of natural radiation in the environment. Thus data are available for total natural radiation in Sweden, Austria, Hungary, Poland and Great Britain.¹ The background measurements in these industrialized countries became imperative in order to assess the increased risk factors^{2,3,4} arising from the introduction of nuclear devices, such as nuclear weapons, reactors, radiochemicals and other artificial sources of radiation. The recent nuclear station accident in Chernobyl, USSR from which radioactive dust escaped into neighboring countries by wind, food items and even by mail, underlies the importance for proper surveillance of radiation levels in an environment. To date, data from the less industrialized

countries especially of the southern hemisphere are fragmentary. Thus the contributions of various mines,^{5,6} building materials^{4,7} and altitude⁸ on background radiation in a country like Nigeria, is not yet fully well documented.

In this communication, we report on problems encountered in a concerted surveillance of outdoor background radiation in some Nigerian towns. With the increased industrialization of even the rural communities, recent telecommunication equipment like masks, many surface and underground exploration mines, the natural radiation load and exposure risks, need to be delineated.

MATERIALS AND METHODS

Natural background radiation was measured with a Mini-instrument environmental detector Type 6 80 with MC 70 Geiger Muller Tube. The instrument was pre-calibrated by the Central Electricity Generating Board of Great Britain. The equipment is such that the distance of the probe from the material being measured can be adjusted to a distance approximately 0.5 meter off the surface of the ground. Five consecutive meter readings for 100 seconds in a central location of a town or borough were averaged: all readings were therefore converted into dose equivalent in micro Sievert/year.

Water and soil samples were counted for radioactivity in two different gamma counters, LKB mini gamma and a Beckman Instrument model and the results were averaged and expressed in Becquerels (the units of number of disintegrations per second).

RESULTS

Table 1 shows the location in the country where background radiation levels were

measured. The values at these locations are also shown in Table 1. A sample of fine sand from Jos, which was used for plastering of houses in that town was measured for absorbed dose levels. The results of such measurements with distances of the probe from sand heap (20 gram) are shown in figure 3. Table 2 is the details of absorbed dose levels of areas of Enugu town with elevation. The average water and soil radioactivity in Bacquerels of different locations in Owerri and Enugu are also shown in Table 3.

DISCUSSION

Natural radiation receives contribution from three main sources:-

- 1) Cosmic radiation from the sun and other galactic emitters.
- 2) Terrestrial gamma rays mainly from the earth crustal materials such as thorium.
- 3) Internal radiation in the body, such as potassium.

It is not surprising therefore that the nearness to the sun (altitude) as well as proximity to the earth's core (underground mines) will increase natural radiation. Our studies confirm that Millikin Hill in Enugu with an altitude of 416 meters above sea level, has slightly higher dose level than Emene with an elevation of 131 meters above sea level. In the vicinity of Onyeama coal mines, we recorded dose levels of much higher doses ($1,755 \pm 52.8$) than normal levels for other Enugu locations (1026.6 ± 148.6), emphasizing that probably, nearness to the earth's crust over-rides the altitude in this instance.

Our survey of towns in Nigeria with a range of 943 - 1755 $\mu\text{Sv}/\text{yr}$ shows our dose equivalent levels are well below global average effective dose from natural sources which is estimated at 2400 $\mu\text{Sv}/\text{yr}$ ⁹ and comparable with those of the United Kingdom, estimated at 1860 $\mu\text{Sv}/\text{year}$ and U.S.A 900 $\mu\text{Sv}/\text{year}$. However some coastal areas of France range between 1,800 to 3,500 $\mu\text{Sv}/\text{year}$. The highest levels have been recorded in Kerala, India with a dose of equivalent of 13,000 $\mu\text{Sv}/\text{year}$ ¹⁰

The startling discovery of "hot" sand in Jos, underlies the importance of building

materials⁶ in exposing sections of our population to natural radiation. There was a linear function between the Radioactivity and reciprocal of distance (squared) of the probe from sand heap. This linear relationship is characteristic of gamma radiation and an indication that one's proximity to a radioactive wall is important in the total dose absorbed. Indeed there are reports not fully documented, of families and household pets presenting radiation sickness and congenital malformation; in some areas of Jos.¹¹

It is comforting to note that surveys of water and sand in Owerri and Enugu show low radioactivity levels, when compared to levels of activity in these samples found in the literature¹³.

The on-going surveillance program from this preliminary beginning, intends to cover the entire country, emphasizing mines, oil fields, quarries and high elevation locations. An attempt will be made to access the levels of gamma radiation in various building materials. The contribution of building materials in natural radiation is emphasized by McAulay and Colgan¹³ and Lopez et.al¹⁴ in their studies in Ireland and Spain respectively which show wide differences in natural radiation based on whether the soil is of limestone, sand stone, granite or volcanic in origin. The dose level data will be analyzed and matched with epidemiological surveys of radiation related diseases.

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TABLE 1
Natural Radiation (dose equivalents in microsieverts/year) in some Nigerian towns.

Location	Dose Equivalents	S.D
Lagos	943.2	$\pm$ 35.9
Ibadan	1146.9	$\pm$ 20.1
Ijebu Ode	1279.0	$\pm$ 14.0
Awka	976.0	$\pm$ 42.7
Benin City	1249.8	$\pm$ 78.8
Owerri	1009.8	$\pm$ 28.1
Port-Harcourt	1073.6	$\pm$ 39.1
ENUGU*	1026.6	$\pm$ 148.6

* Excludes areas around Onyeama Mines.

TABLE 2: Absorbed Radiation Doses at Different Locations in Enugu.

Location	Altitude (meters above sea level)	Background Radiation* (μ Sv/year).
Coal Camp	222.58	1,116.26 $\pm$ 37.7
Emene	131.00	802.8 $\pm$ 74.8
Ngwo	380.98	992.3 $\pm$ 41.5
Millikin Hill	416.00	1,196.7 $\pm$ 65.6
Onyeama Mines	198.11	1,755.0 $\pm$ 52.8

- Data on Altitude was supplied by the Survey Division of the

TABLE 3: Average Radioactivity in Bacquerels in sand and water from locations in Enugu and Owerri

Location	Mean	Range
Enugu	0.80 $\pm$ 0.11	0.62 + 0.092
Owerri	0.78 $\pm$ 0.076	0.58 + 0.085

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