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Activity concentrations of natural radionuclide levels in well waters of Ago Iwoye, Nigeria

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Background: Natural Radioactivity, though natural requires concentration monitoring, especially for the health/ environmental checks of the populace. ***Materials and Methods:*** The activity concentrations of ^{40}K, ^{238}U and ^{232}Th in the waters from wells with depths ranging between 141.0 - 214.0 feet were randomly sampled and determined from 20 locations in Ago-Iwoye town in South Western, Nigeria. ***Results:*** The activity concentrations obtained were in the ranges of (9.9-50.9)Bq/kg with mean value of (25.1± 10.7) Bq/kg for ^{40}K, (BDL-15.0) Bq/kg with mean value of (1.2 ± 3.2) Bq/kg for ^{238}U and (BDL-6.2) Bq/kg with mean value of (1.6 ± 1.7) Bq/kg for ^{232}Th. ***Conclusion:*** According to the results obtained for the activity concentrations from 20 well water samples in Ago Iwoye, Southwestern, Nigeria it was observed that the v^{40}K, ^{238}U and ^{232}Th values were still within the tolerance level indicating minimal radiological health burden on the human populace and the environment. **Iran. J. Radiat. Res., 2010; 7 (4): 207-210**

Keywords: *Well water, depth, locations, activity concentration, health hazard, Ago Iwoye.*

INTRODUCTION

Naturally, occurring radioactive materials (NORMs) had been vital components of the environment and earth crust as far back as when the earth was created. These naturally occurring radioactivity materials disintegrate and emit ionizing radiation to the environment. The concentration of radionuclide in an area depends on the geological setting of the area. 85% of radiation dose to man are from naturally occurring radioactive materials while the remaining 15% is from cosmic rays and the manmade sources [1, 2]. Among the three essentials of life, water is very important to all forms of life making up a larger percentage of the weight of all plants, animals and human body [3].

The gamma radiation from natural radionuclide and cosmic rays constitutes the external exposure while those emanated from ingestion of food and drinking water constitutes internal exposure to humans [4, 5].

Natural radionuclide levels have been studies in surface soils in Ijero Ekiti, in soil and water around Cement Company in Ewekoro, Port Harcourt and in rocks found in Ekiti respectively [4, 6-8]. Results from their studies revealed non-significant levels of radionuclides in the environment. In Ago –Iwoye, the study area (figure 1), pipe borne water is very scarce for drinking. The major source of water for domestic purposes which includes drinking is the well water without any meaningful treatment while drinking well water is traceable to outbreak of epidemics such as cholera and other related diseases [9] . Ago-Iwoye lies on longitude 3° 55' East of Greenwich meridian and latitude 6° 56' North of the equator, it covers a mass area of 460 square km and sited on the basement complex. Ago-Iwoye has an estimated population of about 40,000 as at year 2006 and it happens to be the second largest populated town in Ijebu North Local Government owing to the sitation of Olabisi Onabanjo University (formally Ogun State University) in 1982.

Hence, the aim of the study is to determine the activity concentration of the radionuclide that is contained in the well water consumed by the inhabitants in order to ascertain the health side effects of the

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concentrations on the populace and the environment.

MATERIALS AND METHODS

Sampling

The study area was divided into four grids and five well water samples were collected from each grid. At each location, the water sample was poured into clean container and labeled properly. At the Radiation and Health Physics Laboratory, 250 ml (250 gm) of each water sample was measured with measuring cylinder. The water samples were then transferred into uncontaminated empty cylindrical plastic containers of uniform size (60 mm height by 65 mm diameter). The containers were sealed for about 28 days to allow ^{222}Rn and its short lived progenies to reach secular equilibrium prior to gamma spectroscopy. The sampling locations are shown in table 1.

Measurement

The calibration of the low-level gamma spectrometry system was carried out using certified standard calibration radioactive solutions of Cs-137 (Ref No.: Ro/319/7), U - 238 (RGU-1) and Th-232 (RGTh-1) and Eu-152 (Ref No. : EA3/1496/20866) supplied by the Radiochemical Center Amersham England through the technical aid of International Atomic Energy Agency (IAEA) Vienna, Austria. The samples (well water) were counted for 18000 seconds (5 hrs) using a low-level gamma spectrometry system consisting of a 76 mm x 76 mm NaI (Tl) detector (model No. 802 – series, Canberra inc) coupled to a Canberra series 10 plus multi-channel Analyzer (MCA) (Model No.: 1104) through a pre amplifier base. The detector has a resolution of about 8% at 0.662 MeV, which is capable of distinguishing the gamma ray energies of the radionuclides of interest in this study.

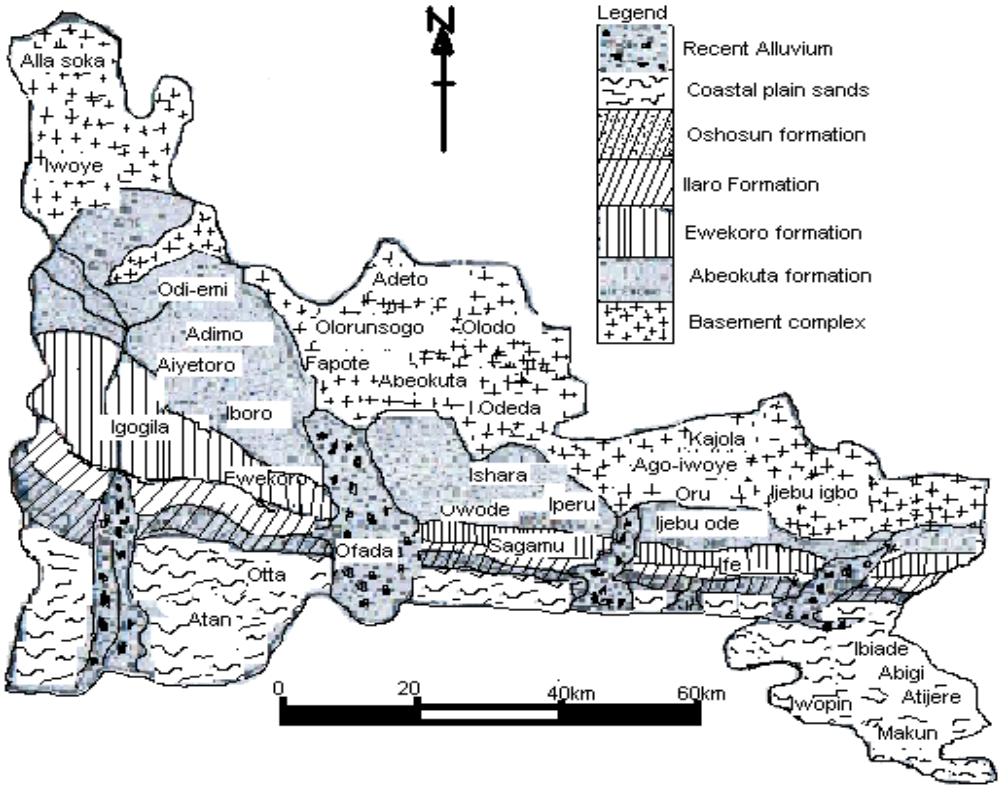

Figure 1. Geological map of Ogun State showing the study area (After Kehinde-Phillips, 1992).

The photopeak at 1.46 MeV was used for measurement of ^{40}K while those at 1.76 MeV peak from ^{214}Bi and 2.614 MeV from ^{208}Tl were used for the measurement of ^{238}U and ^{232}Th respectively. The net area under each photopeak, after background correction, was used to calculate the activity concentration of each radionuclide in the water sample.

The specific activity of the radionuclide in each water sample was calculated using the expression [4]:

$$C = \frac{A}{V \gamma T \varepsilon_p} \qquad (1)$$

Where: C = Specific activity of the radionuclide in BqKg $^{-1}$
A = Net area count under the photopeak of each radionuclide
V = Volume of water sample
T = Counting time.
γ= Gamma yield or absolute probability of the specific gamma ray.
ε_p= Efficiency at specific gamma-ray energy in Bq/kg.

Table 1. Sampling locations of well water samples.

Sample Code	LOCATIONS
S_1	Platinum Hall, Ijesha Road.
S_2	Beautiful Castle, Odugbesan Street. Itamerin.
S_3	Cherith Hall, off, Aiyetoro Street, Aiyegbami.
S_4	C.O.P Hall, Fibigbade Street, off Igan Road.
S_5	WTC Hall, Igan Road
S_6	Latent Church, Adenugba Street, Oke Ebute.
S_7	Liberty Hall, beside Aina filling Station, Itamerin
S_8	Knight Castle, Gasali Street off Ijesha Road.
S_9	Navy Town, Imoro Street, off Imososi.
S_{10}	Amu-Owo Mosque, Ijesha Road.
S_{11}	Quesera Hall, Odugbesan Street off Itamerin.
S_{12}	Radiant Hall, Aiyegbami Street.
S_{13}	Royal castle republic off Onabamiro Street.
S_{14}	Opposite Aina filling station Itamerin.
S_{15}	Ebony Hall Gazali street off Ijesha Road.
S_{16}	Maja Hall off Ijesha Road.
S_{17}	Giften Adekoya Street, Olopomerin.
S_{18}	Obaruwa Street, Aiyegbami.
S_{19}	Opposite Oando filling Station, Igan Road.
S_{20}	Imperial lodge, Igan Road.

RESULTS AND DISCUSSION

The activity concentrations of radionuclides in the well water in Ago-Iwoye township calculated with error from the spectroscopic system are shown in table 2.

The concentration of ^{40}K, ^{238}U and ^{232}Th were in the ranges of (9.9 - 50.9) BqKg $^{-1}$ with mean value of (25.1±10.7) Bq Kg^{-1}, (BDL-15.0) BqKg $^{-1}$ with mean value of (1.2 ±3.2) Bq Kg $^{-1}$ and (BDL-6.2) BqKg $^{-1}$ with mean value of (1.6±1.7) BqKg^{-1} respectively.

Generally the activity concentration level of ^{40}K is more pronounced than the concentration level in either ^{232}Th or ^{238}U, though still within the world acceptable limits for radionuclides.

The activity concentrations of radionuclides obtained in this study compared with the studies of [4, 7, 8, 10] showed that the values though differing slightly for different concentrations of ^{40}K, ^{238}U and ^{232}Th were still very much within accept able limits.

The result trend however, showed that radiological health burden on the human populace is very minimal and has neither health implications nor affect the background ionization radiation.

Table 2. Mean activity concentration of radionuclides in water (Bq Kg^{-1}).

Sample Code	^{40}K	^{238}U	^{232}Th
S1	15.0± 4.5	BDL	5.8 ±1.2
S2	36.0 ±4.1	BDL	BDL
S3	31.0 ±4.1	1.0 ±0.4	BDL
S4	BDL	BDL	6.2 ±1.0
S5	32.4 ±4.1	BDL	BDL
S6	10.3 ±4.5	BDL	1.2 ±0.2
S7	35.2 ±4.1	BDL	BDL
S8	18.2 ±4.4	BDL	4.1 ±1.1
S9	35.1 ±4.1	BDL	BDL
S10	22.0 ±4.4	BDL	2.5 ±1.1
S11	19.9 ±4.4	15 ±0.5	1.1 ±0.9
S12	38.4 ±3.7	BDL	1.6 ±0.8
S13	26.4 ±4.0	2.0 ±0.8	BDL
S14	9.9 ±4.0	BDL	BDL
S15	22.6 ±4.0	BDL	3.9 ±1.0
S16	32.0 ±4.0	BDL	4.3 ±1.0
S17	10.9 ±4.0	0.5 ±0.2	1.9 ±0.3
S18	50.9 ±3.6	BDL	BDL
S19	36.0 ±4.0	BDL	BDL
S20	20.3 ±4.0	5.4 ±0.6	BDL
Mean	25.1±10.7	1.2 ±3.2	1.6 ±1.7

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