International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 669-674 www.ijaem.net ISSN: 2395-5252

Analysis Of Gross Alpha Radioactivity In Ground Water In Maiyama Local Government And Its Environs, Kebbi State,Nigeria

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Submitted: 01-02-2022 Revised: 11-02-2022 Accepted: 14-02-2022

ABSTRACT
The aim of this research work is to analyzed of gross alpha radioactivity in ground water from Maiyama LGAs of kebbi state, Nigeria. Twenty four (24) samples were drawn by means of stratified random sampling from locally dg-wells in the study area and were analyzed using the Eurysis-eight channel gas filled proportional counter. The result obtained from the proportional counter show that the range of alpha activity varied from 0.01 Bq/L to 3.40 Bq/L with geometric mean of 1.705 Bq/L. Therefore, some samples show the higher concentration is above the limit set by World Health Organization (WHO), Environmental Protection Agency (EPA) of value 0.55 Bq/L guideline for alpha activity. From the results obtained from different places in studied area, 71% of alpha activities satisfied the contaminant limit of 0.55 Bq/L and that of 29% were above the limit set out by WHO and EPA.
Keywords: Gross alpha, Radioactivity, Proportional counter Geometric mean, WHO.

I. INTRODUCTION:

Water is one of the most important natural resources and demand for it is on increase. Skillful management of water bodies is therefore required if they are to be used for diverse purposes (Habila, 2008). About ninety-five percent (95%) of all fresh water on earth is ground water found in natural rock formation and domestic activities (Brassard, 1996). Natural and man-made sources of ionizing radiation are present in the environment in which man lives; there is a continuous release of the ionizing radiation in our environment. This is result of the presence of radionuclide is all activities undertaken by man. Naturally, occurring radionuclide's are found in the food we eat, the air we breathe and the water we drink and have resulted in health hazards among the general public. According to the United Nations Scientific Committee on Effects of Atomic Radiation Report (UNSCEAR, 2000),the greater contribution to mankind's exposure is from natural background radiation, and the worldwide external average annual effective dose is 2.4 mSv (UNSCEAR, 2000). However, much higher levels of exposure are usual for inhabitants of natural high background radiation areas. Higher level of radiation above the earth is mainly due to naturally occurring radioactive elements in the earth's crust such as ^{238}U, ^{232}Th and ^{40}K.

Residents in high altitude areas are also more affected by cosmic radiations (ICRP, 1991). Water sources are equally polluted by naturally occurring radioactive materials(NORMS) of the earth's crust (terrestrial radioactivity); which emits α, β and γ radiations. These materials which are normally from the ^{40}K, ^{238}U and ^{232}Th series are more concentrated in deep ground water than in surface water (Onoja, 2004).

They contaminate water bodies directly with their radionuclide products; and indirectly, through the ^{222}Rn and ^{220}Rn gaseous products, which can solidify and attach themselves as aerosols to air particles and are washed down by rain into water bodies (Fasasi, 1999).

Water pollution is the contamination of the water bodies such as lakes, rivers, ocean and underground water by human or natural activities which can be harmful to organisms and plants (Krantz, et. al, 2009). Ground water pollution is much more difficult to abate than surface water pollution because ground water can be more great distances through unseen aquifers.Radioactivity in drinking water is one of the major ways in which radionuclide from the environment gets into the human body, which might consequently lead to radiation-induced disorder (USEPA, 2010). It is therefore important to determine the amount of radioactivity in drinking water for every area where people reside, so as to guard against its deleterious effects (WHO, 2006). Furthermore, flowing water counters shelves sedimentary rocks, igneous rocks and phosphate rock all of which are also radioactive (Sanchiet al., 1989). All these contribute to the level of radioactivity in water. The activity concentration natural radionuclide depends on water sources in the surface water, activity concentration are typically low while drinking water sources from deep wells and boreholes are usually expected to have higher concentration of radioactive nuclei. This is because they pass through fractures in bed rocks or within the soil which contains minerals deposits that might have radioactive constituents and thus leaking into the water ways. Also the concentration increase in summer due to the high evaporation rates and the increase of the solubility of soil due to the higher temperature of the water (Kehagiaet al., 2007).According to (Arnold et al., 1992), some radio-nuclides are chemically similar to some minerals in the human body and so when they are taken into the body the mimic those materials in the organs. Exposure to radiation is harmful to living tissues because of its ionizing power in matter .This ionization can damage living cells directly by breaking the chemical bones of important biological molecules like DNA, or indirectly by biological molecules (UNSCEAR, 2000). In Maiyama LGA of Kebbi State, there has not been any established data on radioactivity in Wells water and boreholes. This survey is therefore important in the sense that it is concerned with the health of the populace. It is equally economical because it will provide data necessary for complete purification of water from wells and boreholes and if the water in the region is safe some health problems will be eliminated and the government will save a lot of money for other developmental effects.

II. THE STUDY AREA

The area under survey is Maiyama LGA metropolis; Maiyama is a LGA in Kebbi State, Nigeria. Itsheadquarter are in the town of Maiyama. It has an area of 1028 km^2 and a population of 176,686 at the 2006 census. Maiyama local Government Area is bounded to the North by Kalgo and Jega LGAs, to the east by Sokoto State, to south by Koko/Besse LG and to the west by Suru local Government Area. Maiyama LGAs located at longitude of $4^o\,21'23.4468''$E and latitude of $11^o\,48'37.08''$N as shown in the topographic map of Maiyama in figure 1.1. Agriculture is the main occupation of the people in Maiyama. Crops produced are mainly grains; animal rearing and fishing are also common. Therefore, ground water (wells and boreholes) is used for various purposes like irrigation, fishing, swimming, drinking for livestock and major source of water supply to the residents of the area.

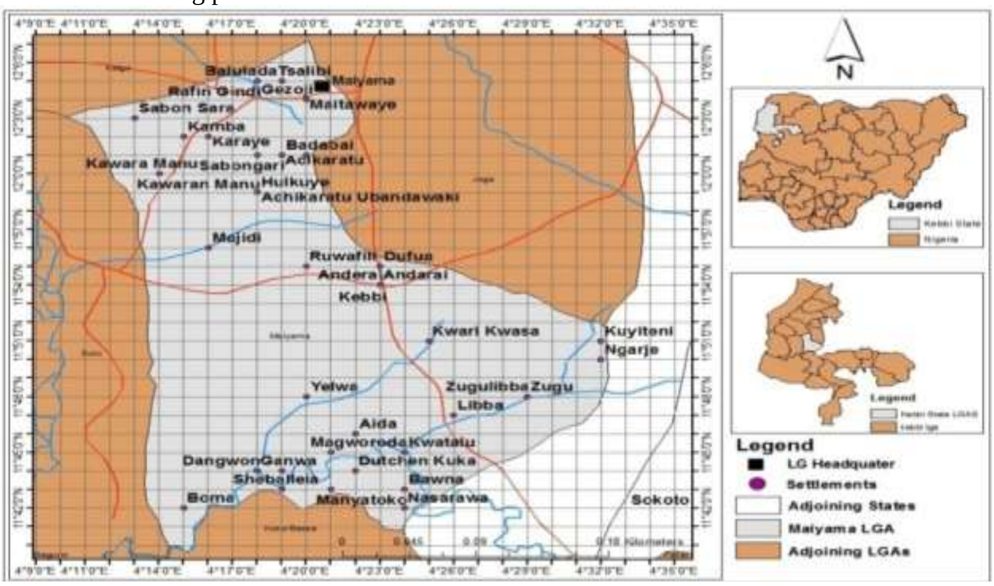

Figure 1.1: Topographic map of Maiyama

III. MATERIALS AND METHODS

There are lots of materials that are going to be involved in this research work, but the most important among them are: gas flow proportional counter for gross alpha and beta counting;

3.1 Sampling materials: Plastic containers- (2 liters), Disposable hypodermic syringe (20 ml) dilute nitric acid, Thermometer, Indelible pen and masking tape, Polyethene bags for sediment sample.

3.2 Sample preparation materials: Hot plate for evaporation, vinyl Acetate, ethanol for even spread of the sample in the planchette, sources for alpha and beta standards, deionized water, planchette (0.3 m in diameter, 0.002 thickness), candle wax and Vaseline.

3.3 Sample Selection

The method adopted for the sampling, is stratified random sampling. The mapped area will be divided into grids. From each grid, one settlement will be selected by simple random process. Two ground water samples will be collected per each settlement.

3.4 Sampling Procedure

Taking reading from Geographical Positioning System (GPS) at each location of sample source; the sample container will be rinse two times with the water being collected, to minimize contamination from original content of the sample container; the amount of water collected was such that an air space of about 1 % of container capacity will be left for thermal expansion; filtration will be done before acidification; about 20ml of dilute nitric acid will be added to the samples for absorption on the walls of the container; the sample will be tightly covered and kept until analyses.

3.5 Sample Preparation

To adhere to the ISO-Standard for radioactivity counting, the collected samples were evaporatedusing hot plates without stirring at moderate heat in an open beaker of 600ml. On average, it took about 24 hours to complete the evaporation of one liter of the each sample. In the evaporation process, when the level of the sample in the beaker reached 50ml, it was then transferred into a Petri dish and placed under infrared light source to completely dry the residue.

The samples were then allowed to cool before weighing. The weight of the residue was obtained by subtracting the weight of empty Petri-dish from the weight of Petri-dish plus sample residue. An empty planchette was weighed after which about0.077g of the residue was transferred to the planchette. 0.077g is arrived from the fact that, ISO-Standard requires about 0.1Amg of residue should be placed on the planchette for counting, where A is the area of the planchette in mm.

The planchetteplus residue was then weighed. A few drops of vinyl acetate is added on the sample to make them stick to the planchette to prevent scattering of the residue during counting. The sample was then kept in a desiccator until ready for counting.

IV. RESULTS AND DISCUSSION

The results of gross alpha activity of the surveyed areas are presented on Table 2.0 as well as Figure 1. These results were discussed and compared with other available results from other areas as no similar work has been done in this present location.

Table 1: Gross alpha activity concentrations measured from ground water in the selected locations within the surveyed area.

S/N	Locations (villages)	Geographical coordinates	Alpha activity (Bq/L)
1.	R/gindi	12.060^0N,4.90^0E	0.48±0.06
2	Sabonsara	12.058^0N, 4.98^0E	0.26±0.11
3	Gezoji	12.055^0N, 4.101^0E	0.06±0.10
4	Maitawaye	12.040^0N, 4.110^0E	0.03±0.02
5	Kamba	12.039^0N, 4.125^0E	0.25±0.02
6	Sabongari	11.0570^0N, 4.178^0E	0.04±0.02
7	K/ Hulkaye	11.075^0N, 4.255^0E	0.21±0.04
8	Karaye	11.068^0N, 4.194^0E	1.20±0.23
9	Achikaratu	11.054^0N, 4.228^0E	1.16±0.02
10	Majidi	$11.04^8$0N, 4.263^0E	2.11±0.22
11	R/Dufua	11.039^0N, 4.215^0E	0.07±0.03
12	Andarai	11.035^0N, 4.210^0E	0.05±0.02
13	Kebbi	11.048^0N, 4.215^0E	0.26±0.10
14	K/ kwasa	11.029^0N, 4.192^0E	1.10±0.14

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15	Yelwa	11.018^{0}N, 4.178^{0}E	0.07±0.02
16	Zugunliba	11.022^{0}N, 4.198^{0}E	3.40±0.32
17	Aida	11.010^{0}N, 4.271^{0}E	0.03±0.02
18	Kwatalo	11.009^{0}N, 4.252^{0}E	3.40±0.32
19	Ganwa	11.017^{0}N, 4.188^{0}E	0.27±0.07
20	D-kuka	11.015^{0}N, 4.182^{0}E	0.22±0.05
21	Bauna	11.021^{0}N, 4.108^{0}E	0.16±0.03
22	Sheballela	11.019^{0}N, 4.125^{0}E	0.13±0.06
23	Boma	11.017^{0}N, 4.120^{0}E	0.04±0.02
24	Nasarawa	11.010^{0}N, 4.122^{0}E	0.01±0.02

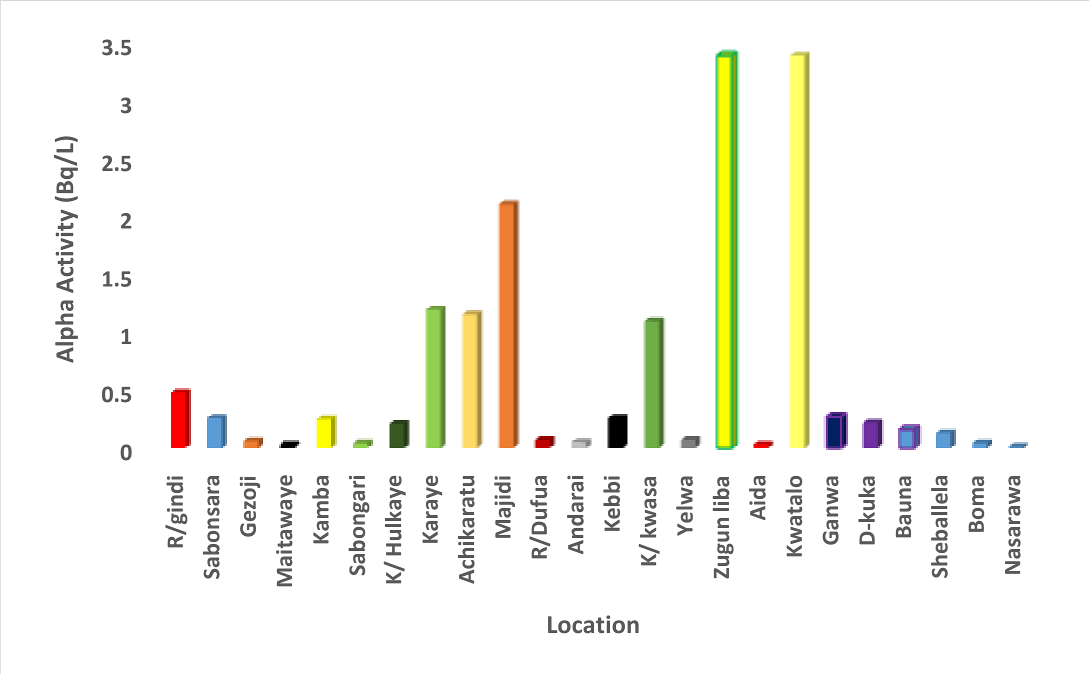

Figure 2.1: Alpha activity concentration for water samples

V. DISCUSSION

Table1. Present the summary of the major results of the gross alpha activity concentrations in ground water from the surveyed area. In the present study, gross alpha activities in majority of the samples below the screening limit set by World Health Organization (WHO), Environmental Protection Agency (EPA) and Australian Laboratory Services (ALS). From the results obtained for alpha activity in different places in the studied area, 71 % of alpha activity in the area satisfies the contaminant limit of 0.55 Bq/L for alpha and that 29 % were above the limit.It could also be observed that the samples collected from Nasarawa, Sheballela, Bauna, Maitawaye and Gezoji have the lowest of alpha. Moreover, the samples collected from Zugun-Liba and Nasarawa villages have the highest and lowest alpha radiations respectively, therefore, there are extensive phosphate rocks and inorganic fertilizers used by the farmers in the area which washes from the surface of the land into the water bodies.According to our findings of the present study, the maximum specific activities caused by radionuclide's emitting alpha particles in ground water of the studied area are 3.40 Bq/L, though the distribution of gross alpha activity concentration shows that the values significantly vary within the samples area.

VI. COMPARISON OF RESULTS

The results of alpha activity measured in the study area and that obtained from other places as well as the WHO, EPA and ALS limits of alpha activity in ground water is shown in Table 2.

Table 2: Comparison of measured gross activities in the surveyed area with WHO and EPA standards and with Results obtained from other places.

Locations	**Range of Alpha (Bq/L)**	**Source of data.**
Belgium	0.006-0.028	CEC, 1982.
Netherland	0.028-0.064	CEC, 1982.
UK	0.030-0.150	CEC, 1982.
Venezuela	0.070-0.540	Sajo-Bohuset al., 1982.
Zaria	0.001-0.043	Onoja, 2004.
Kano	0.002-0.011	Tajudeen, 2006.
Sokoto	0.010-6.000	Saidu, 2013.
Maiyama	0.010-3.400	This work.
	≤ 0.5	WHO
	≤ 0.55	EPA.

The results also shows that the low level of alpha activity concentrations activity concentration agree with the report by (Nwoke, 2006) carried out in Kaduna state, (Tajudeen, 2006) on Wells and Boreholes in Kano State and (Saidu, 2013) on well and borehole in Sokoto State, both in the North-West Nigeria. However, the results deviates slightly from that (Onoja, (2004) carried out in Zaria on well water. All these reports suggested high contaminations in hand dug-wells in this part of the country.

VII. CONCLUSION

The gross alpha activity concentration in almost all the available hand dug well water within Maiyama LGAs of Kebbi State, North-Western, Nigeria have been evaluated. In the current study, twenty –four (24) ground water samples were collected from different settlements in the surveyed area. The ISO9696 method of alpha activity analysis in non-saline water was applied to determine the gross alpha activity concentrations. Therefore, it may be concluded that while water from majority wells in the surveyed area meet the recommendation of the USEPA and WHO standard, some do not meet the USEPA and WHO standard of 0.55 Bq/L. However, it may not pose any serious health side effects to the public users in the surveyed area.

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