DETERMINATION OF GROSS ALPHA AND BETA ACTIVITIES IN DRINKING WATER IN FASKARI L.G.A OF KATSINA STATE

BY

Abubakar Haruna
ADM. NO; 1410310019

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DETERMINATION OF GROSS ALPHA AND BETA ACTIVITIES IN DRINKING WATER IN FASKARI L.G.A OF KATSINA STATE

Abubakar Haruna
(1410310019)

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DECLARATION

I, Abubakar Haruna, so hereby declare that this entire project report is my project experience written to the best of my knowledge. It has not been submitted anywhere else before for the award of a Bachelor of Science degree. All information derived from published and unpublished sources as well as other authors have been duly acknowledged in the text.

Abubakar Haruna

25-11-2018

Date

CERTIFICATION

This is to certify that this report is an original work undertaken by Haruna Abubakar (1410310019) under supervision and has been reported in accordance with the regulations of Federal University Gusau, Zamfara State and is approved for its contribution to knowledge.

Dr. Lawal Sa'ad
(Head of Department)

Sign & Date

Mr. Maduka Nosike C.
(Supervisor)

12-12-2018
Sign & Date

Prof. (Mrs) B.A. Shinkafi
DEAN FACULTY of SCIENCE

17/12/2018
Sign & Date

Prof A.O Musa
(External Examiner)

A O Musa 27/11/2018
Sign & Date

DEDICATION

This research work is dedicated to my late parent and also my uncle for his support throughout my academic career.

November, 2018

ACKNOWLEDGMENT

I would like to thank my Supervisor Mr. Maduka Nosike.C for his guiding throughout this work and for granting me the opportunity to conduct research within the radioactivity at Faskari L.G.A Of Katsina State.

I also have gratitude for the valuable advice and collaboration received from Late Dr. Zakari and HOD Physics Dr. Lawal Sa'ad. I would also like to thank Mal. Isah Abdulmuminu.

I will always remember all the friends and colleagues I happened to meet during this exciting 4-year period, whether in F.U.G or CERT ABU Zaria, it's been fantastic to meet you all: Lawal Isah, Muhammad Umar, Abdulkadir Shuaibu, Ofodile Daniel Chinedu, Abodunde Abayomi Ojo, Hamida Haruna, Muhammad ayagi, Ibrahim A. khamisu ...hope I am not forgetting anyone....

However, it wouldn't have been possible, hadn't been for the unconditional support and patience received from my family: Oscar and family, my parents and my brother! Also my closest friends, thanks for not asking about my thesis!

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ABSTRACT

Five water samples were drawn at random from locally dug well, river, dam and borehole in Faskari Local Government Area of Katsina State (Northern Nigeria) in two litters of each, 10ml of concentrated nitric acid were added for preservation and evaporated in a beaker and transferred into a plancet till often residue. The samples counted for gross alpha and beta activity with proportional counter. The counter was characterized for background, plateau and detection-limit. From the characterization results, it was discovered that the counter showed low background, good plateau and low detection limit of the samples. It shows that the counts taken from channel were reproducible for the channel and for mode of counting. The overall result showed that the alpha activity in water is secure while for beta activity, is only one area which is Tukusha has (1.603) Bq/l, that the activity is higher than the practical screening level of radioactivity in drinking water of 0.5 Bq/m^3 for alpha and 1.0 Bq/m^3 for beta as recommended by CEC-FAD and World Health Organisation (WHO).

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Th	Thorium
U	Uranium
Ra	Radon
Rn	Radon
Sv	Silvert
Bq	Bequeral
β	Beta
α	Alpha
°C	Degree Celsius
V	Voltage
S	Second

LIST OF EQUATION **page**

CHAPTER ONE

1.0 Introduction

1.1 Radioactivity in Water

Water is a necessity to man and his environment; it existed long before man came into existence. Man uses water for the following purposes: irrigation, power generation and domestic activities. Sources of water are rain and ground waters as found in rivers, dams, lakes, and streams. Human activities and natural phenomena constantly pollute the sources of water and affect water quality. Water pollution arises as a result of waste sewage disposal into the environment and rivers by industries, hospitals and use of materials such as fertilizers by farmers. These disposed materials often contain radionuclides. Another form of water pollution as a result of Naturally Occurring Radioactive Materials (NORM) that emits alpha, beta and gamma radiation. These usually have element in uranium and thorium series whose radioactive gaseous daughter (radon and thoron) in particular cause an appreciable airborne particulate activity and contribute to the radioactivity of rain and ground waters. This also affects drinking water. Drinking water from deep wells is expected to contain a higher concentration of radioactive elements compared to surface water. Flowing water may encounter igneous and sedimentary rocks, shelves, and phosphate rocks rich in daughters of uranium and thorium series in its course. Furthermore, man-made alpha emitters, such as plutonium, and americium could be transported into springs or wells there upon enhancing the activity level of the water. Radioactivity in drinking water is an important mode of transfer of radionuclides from the environment to man. The most important natural radionuclides in drinking water are tritium, potassium-40, radium, radon and their decay products, which are in essence beta and gamma emitters. Therefore, there is the need to determine the concentration of alpha, beta, and gamma emitting radionuclides in water.

Radioactivity in drinking water is an important mode of transfer of radionuclides from environment to man. The most important natural radionuclides in drinking water are tritium, potassium-40, radium, radon and gamma emitters. Therefore, measuring the radioactivity in drinking water is of great interest in environment studies. A gross alpha test is the first step to determining the level of radioactivity in drinking water. This test serves as a preliminary screening device and determine whether additional is advisable (WHO 2006). Gross alpha is more of concern than gross beta for natural radioactivity in water as it refers to the radioactivity of Th, U, Ra as well as Rn and daughters (USEPA, 1997). If the gross alpha and gross beta are less than 0.5 and 1.0Bq/L respectively, it can be assumed that the Total Indicative Dose (TID) is less than the parametric indicator value 0.1mSv/year and no further radiological investigation is needed. If the gross alpha activities exceed 0.5Bq/L or gross beta activity exceeds 1.0Bq/L, analysis for specific radionuclides is required (WHO, 2003). Parts of Katsina State and environs, like many other parts in the country, due to portable water scarcity, people normally collect water from wells, Rivers and boreholes (deep and shallow). The public water boards are generally ineffective in supplying portable drinking water; therefore most of the populations rely on untreated ground water sources (borehole, rivers and well) for domestic and industrial purposes. The ground water collected from dug wells and boreholes samples are not entirely free from radioactive pollutants which are hazardous to human health.

Therefore, there is need to determine the concentration of gross alpha and gross beta particles in wells and boreholes water from these areas, assess the radiological health risks due to consumption of water from wells, rivers and boreholes sources on the area because communities from all parts of the country and beyond are involved. This research help in understanding a quantitative detection of gross alpha and beta radioactivity which is important for a quick survey of both natural and man-made radioactivity in dug-wells and boreholes water in the study area. Radioactivity in drinking water is one of the major ways in which radionuclides from the environment gets into the human body, which might consequently lead to radiation-induced disorder (USEPA, 2010). There is evidence from both human and animal studies that radiation exposure at lower to moderate doses, may increase the long term incidence of cancer and that the rate of genetic malformations may increase by radiation exposure (Otton, 1994). 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).

1.2 Statement of Research Problems.

Inflow of waste-water from industries and rainwater flowing over farmland into the rivers and other water bodies constitute a source of pollution to drinking water in a particular area. Pollution may constitute heavy elements, as well as radioactive elements whose existence could prove to be hazardous to health. Data on radioactivity in drinking water is therefore important in determining quality and the health impact such water could have on the populance. In the Faskari Local Government Area, there is yet no established data on the radioactivity level in drinking water sources. Most of the rural inhabitants of this area depend on water from wells, rivers, and boreholes for drinking, household activities and irrigation. It may be possible that the water they use contain excess of Naturally Occurring Radioactive elements. Many farmers plant their crops close to the riverside and most of them make use of fertilizers on their farmlands. As rain falls, it washes some of this fertilizer into the underground water. The fertilizers contain phosphates, which has a radioactive compound k-40, a beta and gamma ray emitter other elements. This actually can enhance the amount of radioactivity in drinking water and its contribution has not be investigated. The Centre for Energy Research and Training, Zaria has acquired a proportional counter, which has been characterized and put it into use. Therefore, the aim of this research is to use it to develop data that will benefit the health of the people of Faskari L.G.A of Katsina State.

1.3 Theory

1.3.1 Radioactivity

For any element there is limited number of neutrons within the nucleus for it to remain stable. Any deviation from this number will result in an unstable atom. An unstable atom can become more stable by emitting energy in the form of radiation. Such atoms are said to be radioactive and the process is called radioactivity. Natural radioactive was discovered by *Henri becquerel* in 1896. He fund that a photographic plate gets blackened, where place near double sulphates of potassium and Uranium. Further observations in this respect led Becquerel to the conclusion that uranium emitted special kind of rays and such rays were called Becquerel rays and such rays were called Becquerel rays. *Pierre* and *marrie curie* found that the radiation from pitchblende was found times stronger than that emitting from uranium. This led to an intensive search for the source of stronger radiation. Finally, in (1898) they succeeded in discovering two new substances, which they named polonium ($^{210}_{84}Po$) and radium ($^{210}_{84}Ra$).

The spontaneous transformation of an element into another with the emission of some particle (or particles) or electromagmatic radiation is called natural radioactivity.

The substances capable for emitting radiations are called radioactive substances. As a rule, radioactivity is displayed by the heavy nuclei occurring at the end of the periodic table beyond lead.

Apart from naturally occurring radioactive substance, the radioactivity can also be induced by artificial means through nuclear transmutation. The phenomenon of artificial radioactivity was discovered by *joliot* and *curie*, when then they bombarded aluminium with alpha particles obtained from polonium. They found that even when the source of alpha particles was removed, the aluminium pieces continued moving off some type of radiation. Also, it was found that the rate of emission of the radiation was found to decrease exponentially as is the case with natural radioactivity. Hence, the phenomenon was termed as artificial radioactivity. The nuclear transformation as follows:

$$^{4}_{2}He + ^{27}_{13}Al \longrightarrow ^{30}_{15}p + ^{1}_{0}n \quad \text{......} (1.1)$$

The isotope $^{30}_{15}p$ is unstable and radioactive. It decays as follows:

$$^{30}_{15}p \longrightarrow ^{30}_{14}Si + ^{0}_{1}e + \gamma \quad \text{......} (1.2)$$

The half-life period of radioactive phosphorus is found to be 2.2 minutes (132 seconds). Soon, other scientists started investigations and found that not only the alpha particles but other projectiles like proton, deuterons and neutrons can include artificial radioactivity. Further intense discoveries revealed that X-rays and gamma rays from radioactive substances) belong to electromagnetic radiations of some velocity and slightly different wavelengths. They are ionizing radiation, which can discharge a charged electroscope. Alpha and Beta particles are also ionizing radiations. The essential difference between X-rays gamma rays is origin. Whereas gamma rays result from charges in the nucleus, X-rays are emitted when atomic electrons undergo a change in orbit (Steven and Ann, 2002).

1.3.2 Radioactive Decay Law

Rutherford and soddy studied the phenomenon of radioactivity in details and formulated the following laws, known as the law as of radioactive decay:

1. Radioactivity is a spontaneous phenomenon and one cannot predict, when a particular "atom in a given radioactive, sample will undergo disintegration".
2. When a radioactive a heavy atom disintegrates, either an alpha particle (nucleus of helium) or a beta particle (electron) is emitted.

The new atom so formed (called daughter atom) may emit a gamma ray photon, in case the nucleus is left in excited state on emitting the alpha or beta particles). Further, both alpha and beta particles are never emitted simultaneously. It may also be pointed out that a radioactive atom can never emit more than one alpha particle or a beta particle at a time.

3. The number of atoms disintegrating per second of a radioactive sample at any time is directly proportional to the number of atoms present at that time. The rate of disintegration of the sample cannot be altered by changing the external

factors, such as pressure, temperature, e.t.c it is known as radioactivive decay law.

Consider that a radioactive sample contains N_0 atoms initially (t = 0). As the time elapses, the atoms of the sample decrease due to disintegration. Suppose that after time t, the number of the atoms reduce to N and after time t + dt, the number of atoms further decrease to N-Dn. Obviously, in the time interval between t and t + dt i.e. equal to dt, the number of atoms decrease by N-(N-dN) i.e. dN.

Therefore, rate of disintegration of atoms at time t is:

$$Rt = \frac{dN}{dt} \quad \text{.......}(1.3)$$

According to radioactive decay law:

$$\frac{dN}{dt} \propto N$$

$$\frac{dN}{dt} = -\mu N \quad \text{.......}(1.4)$$

Where the constant of proportionality μ is called decay constant of the radioactive sample. It is also known as disintegration constant or transformation constant. The negative sign shows that N decrease as time, t increases.

$$=\frac{dN}{N} = -\mu dt$$

Solving equation by integration and taking natural log will result in equation

$$N= N_0 e^{-\mu t} \quad \text{.......}(1.5)$$

Where N_0 is the number of atoms of the radionuclide at time t = 0. Equation is the radioactive decay law.

1.3.3 Half Life ($T^{1/2}$)

Different radionuclides are transformed at different rates, and each radionuclide has it own characteristic transformation rate. Thus the time required for any given radionuclide to decrease to one-half of its original quantity is called half-life ($T^{1/2}$) of the radionuclide (cember, 1996). The half-life of a radionuclide is a measure of the speed with which it undergo radioactive transformation. From equation (1.2), at half-life, $N = N_0/2$ and $t = T^{1/2}$ so that the equation transformation to

$$\frac{dN}{N} = N_o e^{\wedge} T^{1/2} \qquad (1.6)$$

Solving the equation, gives

$$T^{1/2} = \frac{\ln 2}{\mu} \qquad (1.7)$$

1.3.4 Activity of Radioactive Substance

The activity of a radioactive substance may be defined as the rate at which the nuclei of its atoms in the sample disintegrate. If a radioactive sample contains N atoms at any time t, then its activity at time t is defined as

$$R = -\frac{dN}{dt} \qquad (1.8)$$

The negative sign shows that with the passage of time, the activity of the radioactive substance decreases.

Since according to the radioactive decay law,

$$\frac{dN}{dt} = - \mu N,$$

The equation (1.8) may be expressed as

$$R = \mu N \quad \text{.......(1.9)}$$

Since $N = N_0 e^{-\mu t}$ we have

$$R = N_0 e^{-\mu t} \quad \text{.......(1.10)}$$

$$R = R_0 e^{-\mu t} \Longrightarrow At = A_0 e^{-\mu t} \quad \text{.......(1.11)}$$

The activity of a radioactive sample is called one curie, if it undergoes 3.7×10^{10} disintegrations per second. Thus,

1 curie (Ci) = 3.7×10^{10} disintegrations S^{-1}.

1.3.5 Specific Activity

Although, the activity is used as a measure of the quantity of the radionuclide present, it does not consider mass or volume of the radioactive material. The relationship between the activity and the mass of the radioactive material is called the specific activity, which is the activity per unit mass of the radioactive material (cember, 1996) specific activity is the measure of activity concentration of a radioactive material; expressed as:

$$Asp = \frac{Act}{A} = \frac{\mu NA}{A} \quad \text{.......(1.12)}$$

Where N_A the Avogadro number and A is the atomic mass of the radionuclide.

1.4 Objectives.

The objectives of this work are as follows:

I) To evaluate the gross alpha and beta activity in drinking water from wells, dams, rivers and boreholes in Faskari Local Government Area of Katsina State.

II) To establish the distribution pattern of radioactivity measured in the areas in order to identify areas of elevated activity if any.

III) To ascertain the safety of drinking water in the Faskari Local Government Area of Katsina State.

IV) To provide data that will benefit the health of the people of Faskari Local Government Area of Katsina State.

1.5 Justification

Radiation is hazardous to human health. Alpha and beta particles deposited their energy at short distances and cause damages in the organs when ingested along with water. Its important that drinking water be characterized with respect to radionuclide content. Because nuclide characterization is costly, gross alpha and beta counting becomes a necessary preliminary test as stimulated by the World Health Organisation (WHO) guideline for water quality determination. Radionuclide specific test becomes necessary only if the result of the preliminary test exceeds a recommended value. Therefore, establishing a gross alpha and beta counting system, would not only contribute to the health of the populace but also economical in that it offers a more cost effective means of screening drinking water. The characterization of proportional counter acquired in the Centre for Energy Research and Training, Zaria, was used to carry out this research work.

This work has not been done before, therefore the data generated will be a significant contribution to literature.

CHAPTER TWO

2.0 Literature Review

Researches had been carried out in the field radioactivity in water in different parts of world in the past. A survey had been carried out to determine radioactivity in water sources in Okpare– creeks, Delta State (Jibril et al., 1999). In their work it was deduced that the alpha and beta activities in the Okpare creek are far below the practical screening level of radioactivity in drinking water of 0.5Bq/L for alpha and 1.0Bq/L for beta recommend by WHO. Onoja (2004) determined gross α and β activities in well water in Zaria area of Kaduna State. The result shows a geometric mean value of 75.53 Bqm3 (or 0.075 BqL^{-1}) for β activity. Tajudeen (2006) carried out a similar work in the Gwammaja area of Kano Metropolitan City and the result shows a geometric mean value of 0.05 Bqm3 for β activity. Habila worked on the survey of gross beta radioactivity in wells and boreholes from Jos city. The result shows that the range of β activity varied from 0.25 to 9.64 Bq/L, with a geometric mean of 1.56 Bq/L (Habila, 2008).

The aim of this research is to determine the gross radioactivity concentration in the area. This study will also ascertain the safety of drinking water in well, river, dam and borehole water sources from the study area.

CHAPTER THREE

3.0 Materials and Methods

The method used for the sampling is stratified random sampling (Williams, 1977). All the collected water sample where evaporated in order to obtain their various residues. The sampling procedures include the following: The sample container was rinsed three times with the water being collected to minimize contamination from the original content of the sample container. The amount collected was such that an air space of about 1% of container capacity was created for thermal expansion was left, The water samples were immediately acidified with 10ml of nitric acid per 2 liters of sample collected to reduce PH and to minimize the absorption of radioactivity into the walls of the containers (ISO, 1992) and the samples were tightly covered and kept in the laboratory for analysis.

For the purpose of analysis, an Acetone (a cleansing agent) was used to wash the equipment needed for the Sample preparation. About 500ml of the sampled water was measured and transferred to a beaker. The sample was evaporated carefully on a Binatone temperature adjustable hot plate. The evaporation was done at the temperature less than 100°C for eight hours until the volume was reduced to about 100ml and allowed to cool. The concentrated solution was transferred to a weighed Crucible. The beaker was carefully washed with a minimum amount of water and the washings transferred to the Crucible. The sample was heated again to dryness and residue obtained. The Crucible and residue were weighed and by subtraction, the mass (mg) of the ignited residue was obtained. The residue was dispersed evenly over the planchet with minimum required weight of 0.0770 after zeroing the weight of planchet by slurring with a few drops of ethanol and allowed it to stick together, all this was done by using analytical weighing balance. The planchet was weighed again to ensure that no residue has been lost. This procedure was repeated for all the samples. The actual volume of the residue was been calculated by converting the total sum evaporated volume of water of the beaker into ml by weight of residue (g) multiply by Required Weight (g).

$$sample\ volume = \frac{V}{M} \times Rw \quad (3.1)$$

where

V= volume of water sample evaporated in litres

M= residue mass in (mg) from V

Rw = Required Weight (g)

Where the sample preparation efficiency was derived by taking the weight of the empty planchet W_B and the weight of the planchet plus sample after evaporation to 100ml, W_{B+S}. The difference between W_{B+S} and W_B gives the weight of the residue. The ratio of the difference between the weights of the residue to 0.0770g as specified by ISO multiplied by 100 gives the sample efficiency as shown in equation (10).

$$Sample\ Efficiency = \frac{W_{B+S} - W_B}{0.0770g} \times 100\% \quad (3.2)$$

where

W_B = Empty planchet.

W_{B+S} = Empty planchet plus sample.

The gross alpha/beta counting equipment used in this work is the MPC-2000-DP low background alpha/beta detector. The alpha standards were ^{239}Pu whose half life is 24110years, while the beta standards were ^{90}Sr whose half life is 28years. Their respective activities were calculated at the time of the calibration source used to determine efficiency in the proportional counter and are presented in chapter three. The equipment is a non-gas proportional counter with an ultra-thin window. For the gross alpha/beta counting, the desired weight of 0.0770g of residue on the planchet was transferred to the sample carrier of MPC-2000-DP model detector. Plateau test from proportional counter was run with the manufacturers calibration standards (^{239}Pu and ^{90}Sr) whose activities ranges from 133.29 to 185.51Bq and 92.31 to 103.68Bq, respectively in all the three operating modes. This test was run for 1800s for five cycles.

The carrier was then placed on the sample drawer and closed. Counting was done automatically according to the selected count mode when the appropriate sample information was entered (The detector was operated in alpha and beta modes to obtain the count rates of alpha and beta in counts per minutes respectively). For gross alpha counting, the high voltage was set at 1600V and samples were counted for 5 cycles of 2700s per cycle. While the high voltage for gross beta counting was set at 1700V and samples were counted for 5 cycles in beta only mode. The results were displayed as raw count; count rate 45min (count/min), activity and standard deviation. The results were displayed as raw counts, count rate (CPM) were repeated three times each for all the samples and the average value was obtained respectively.

The activity concentration (C) in Becquerel's per Litre was calculated using equation (3).

$\alpha \; or \; \beta \;\; (Bq/l)$

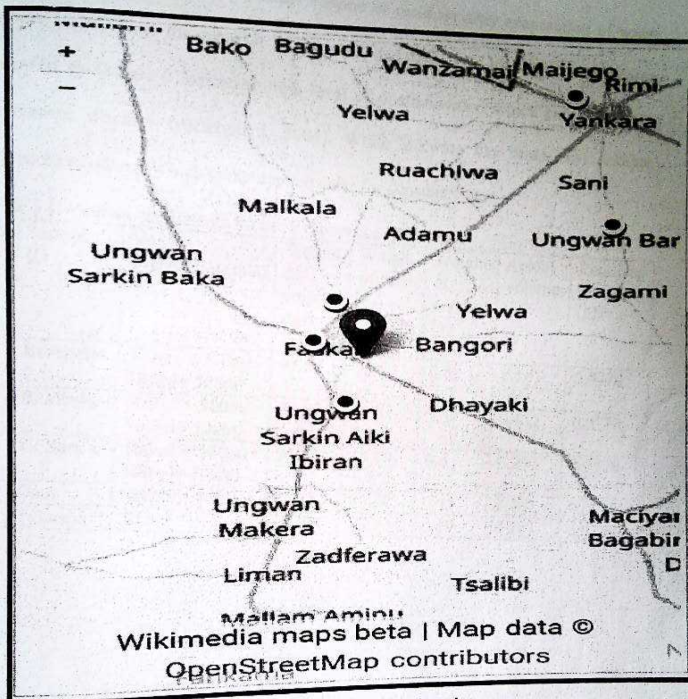
$$= \frac{Net\ count\ (CPM)}{sample\ eff\ \ x\ sample\ size\ \ x\ detector\ eff} \times 0{,}0167 \ldots\ldots (11)$$

To get the net count, equation (12) was used.

$$Net\ count = Rows\ count\ (CPM) - Background\ (CPM) \ldots\ldots\ldots\ldots (12)$$

3.1 Sampling Location Map

The sample for the analyses were collected from Faskari L.G.A of katsina state and its environments.



.... Sample point

.... Main road

.... Lake

CHAPTER FOUR

4.0 Result and Discussion

Table 3.1 shows the calculated actual volume of residues after evaporation of water sample in ml, from the table, it is observed that Dam has highest actual volume followed by U/Bara'u indicating high level of contamination which can be lead to waterborne diseases (vestergaard, 2004). While B/kwata has much less residue compared to others. Which make it much safer for consumption.

Table 3.1:- Shows the Results for the Evaporation of Water .

S/n	Sample ID	Vol. evaporation(mls)	Weight of empty dish (g)	Weight of dish + Sample (g)	Weight of residue (g)	Actual volume	Required Weight (g)
1	Boreholes 1	500ml + 500ml+ 500ml+ 500ml	95.17	95.99	0.82	0.187	0.0770
2	B/ kwata	500ml + 500ml+ 500ml+ 500ml	75.94	77.31	1.37	0.112	0.0770
3	U/ Bara'u	500ml + 500ml+ 500ml+ 500ml	95.19	95.79	0.6	0.257	0.0770
4	Dam	500ml + 400ml+	95.13	95.28	0.15	0.462	0.0770
5	Tukusha	500ml	75.91	79.10	0.19	0.203	0.0770

Table 3.2: Count Table for Alpha and Beta.

s/n	Sample ID	Alpha count	Alpha CPM	Alpha count average	Alpha CPM average	Beta count	Beta CPM	Beta count average
	BGK	125	4.17			94	3.13	
		24	0.80	59	1.96	54	1.80	63
		28	0.93			41	1.37	
1	Boreholes 1	80	2.67			37	1.23	
2	B/ kwata	30	1.00			40	1.33	
3	U/ Bara'u	75	2.50			59	1.97	
4	Dam	36	1.20			73	2.43	
5	Tukusha	57	1.90			136	4.53	

The concentration of gross alpha and beta particles in water by using proportional counter is as shown in Table 3.2. the table depicts that borehole 1 has the most alpha CPM and that of Tukusha has the most beta CPM. This means that they have high concentration of alpha and beta radioactivity respectively.

Table 3.3:- Result of Gross Alpha/beta Radioactivity's in test water Samples

S/NO	SAMPLE ID	Alpha Radioactivity Concentration (Bq/l)	Beta Radioactivity Concentration (Bq/l)
1.	Bore hole 1	$(7.09 \pm 3.98) \times 10^{-02}$	$(2.606 \pm 4.25) \times 10^{-01}$
2.	Tukusha	$(2.64 \pm 5.88) \times 10^{-02}$	$(1.603 \pm 0.79) \times 10^{-00}$
3.	B/kwata	$(1.15 \pm 2.17) \times 10^{-02}$	$(2.051 \pm 3.79) \times 10^{-01}$
4.	Dam	$(6.39 \pm 0.12) \times 10^{-03}$	$(2.084 \pm 2.27) \times 10^{-01}$
5.	U/bara'u	$(4.95 \pm 3.18) \times 10^{-02}$	$(3.845 \pm 1.00) \times 10^{-01}$

The alpha and beta radioactivity's water samples is as shown in Table 3.3. It can be deduced from the table that Borehole 1 has the highest alpha activity, having the value of $7.07 \pm 3.98 \times 10^{-2}$ Bq/l, where Dam has the lowest alpha activity value of $6.39 \pm 0.12 \times 10^{-3}$ Bq/l. Through all the values of alpha activities are below the recommended value set by WHO which is 0.5 Blq/l. While for beta activity, the lowest value is from (B/kwata) which is $(2.051 \pm 3.79) \times 10^{-01}$, and the highest value is from (Tukusha) which is, this may attributed to the geological formation of the area and industrial wastes, such as chemicals that may contain beta emitting elements used in fertilizer industries which are washed into the river and streams located in the area. With the value of $(1.603 \pm 0.79) \times 10^{-00}$ Bq/l, it is inferred that beta activity is higher than the practical screening level of radioactivity in drinking water of 1.0 Bq/m^3 for beta as recommended by WHO and therefore is not fit for consumption.

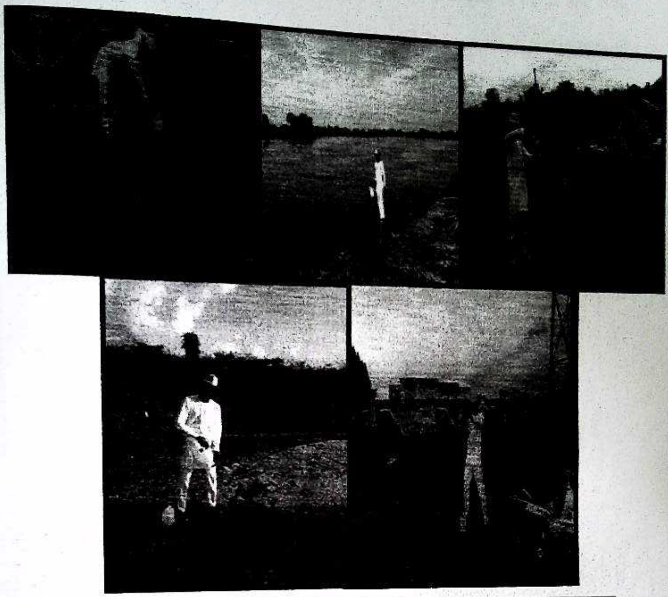


Figure 3.1: shows pictures of where water sample were collected

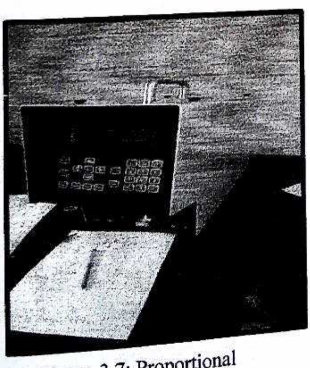


Figure 3.7: Proportional

Figure 3.8: Analytical weighing balance

For easy assessment and comparison of result a bar chart was drawn of alpha and beta activities of the different water samples, with these graphs, it is easier to compare with the WHO standard to verify if samples activity values are within regulatory limit.

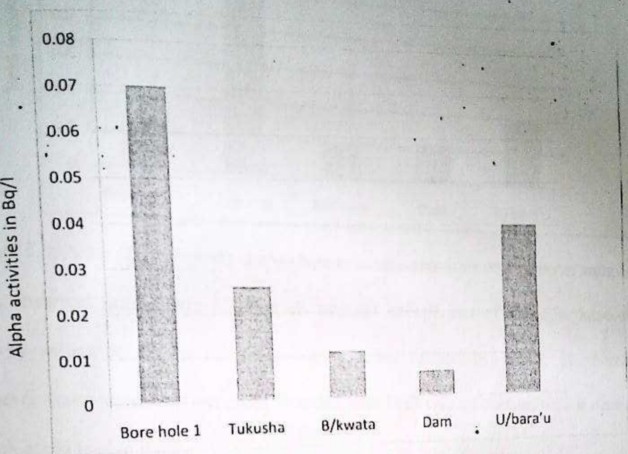


Figure 3.4: A bar chart showing the various in alpha activities on test water sample.

The results as seen in Figure 3.4 is in agreement with table 3.3. Bore hole 1 has the highest alpha activity, while Dam has the lowest alpha activity.

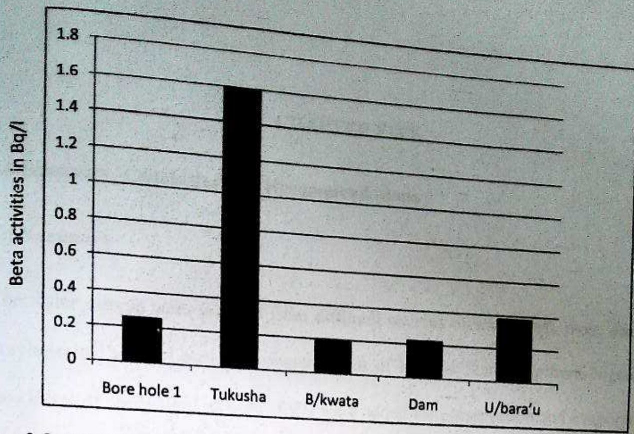


Figure 3.5: A bar chart showing the variations in beta activities on test water samples.

It is observed from figure 3.5 that all samples except that of Tukusha have beta activity values below the recommended value of 1.0Bq/l by WHO. So therefore whoever that consumes water from Tukusha area is at risk of contaminating diseases which could lead to death.

CHAPTER FIVE

5.0 Summary, Conclusion and Recommendations

5.1 Summary

The water sample were selected from different sources of water well, river, dam and borehole in Faskari Local Government Area of Katsina State (Northern Nigeria) in two litters of each, 10ml of conc.$HN0_3$ were added for preservation and evaporated in a beaker and transferred into a plancet till often residue. The samples counted for gross α and β activity with proportional counter. The counter was characterized for background, plateau and detection-limit. From the characterization results, it was discovered that the counter showed low background, good plateau and low detection limit of the samples. It shows that the counts taken from channel were reproducible for the channel and for mode of counting. The result discovered that the alpha activity in water is safe while for beta activity, is only one area which is Tukusha has (1.603) Bq/l, that the activity is higher than the recommended value of 0.5 Bq/m^3 for alpha and 1.0 Bq/m^3 for beta given by CEC-FAD and World Health Organisation (WHO).

5.2 Conclusion

Base on the results gathered, it is obvious that the water samples investigated have a low concentration of alpha emitters and therefore have alpha activities less than 0.5Bq/l for the samples. On the other hand all the water samples have beta activities below 1.0 Bq/l except in Tukusha where the activity is 1.6Bq/l. It is therefore evident that water from all the selected locations is safe for consumption unless in Tukusha that has the highest value of beta radioactivity which is above the set value by WHO.

Continuous consumption of water from the affected area could lead to disease which can result to death. To the best of our knowledge, this is the first detailed study of gross alpha/beta activity concentration in well, river, Dam and Borehole water samples in some parts of Katsina south-west and its Environs. However, more research has to be done in order to identify the individual radionuclides contributing to the total gross radioactivity. This is a matter of further research work.

5.3 Recommendations

The factors that determine the safety before consumption of water is very necessary because the cytoplasm which is the basic substance of the cell is made up of 80% water and modern research as also revealed that most organisms consist of 50% to 90% water and that every living entity requires water for its existence. This method of checking water for gross alpha and beta activity concentration is necessary. Hence, this method is necessary for developing countries, where human activities are not regulated and environmental release of radionuclides are likely to affect drinking water. Establishment of monitoring programs to ensure water treatment, is necessary. The sampling and analysis for radionuclides should be carried out routinely enough to characterize the gross alpha and beta annual exposure. This will help to check disease that may be caused by radiation. Also federal government and state government should partner with the researchers and sponsor enlightenment programs in other to create awareness and to safeguard the health of the citizens. This could be achieved through extension services. Physics departments in our various universities can also play an important role in creating awareness on projects related to human health by disseminating information on research finding to the necessary body. The results obtained from the analysis of the water samples could be used as bio-data of an environmental contamination.

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