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Assessment of Cancer Risk from Potassium-40 in Sachet Water Consumed in Mubi Local Government Area, Adamawa State, Nigeria

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Abstract

Sachet water is a major drinking water in Mubi. This research assessed Potassium-40 (40K) radioactivity concentration in sachet water consumed by Mubi dwellers and the associated cancer risks. Samples from fifteen (15) sachet water brand were analyzed at Centre fur Energy Research and Training (CERT) Ahmadu Bello University Zaria (ABU) using gamma spectrometry. The results for the analysis showed that Potassium-40 concentration in sachet water from the sampling locations ranged from 36.08 - 98.9IBq/L and the cancer risk ranged from 0.0000082 - 0.000022 Risk/year for location M8 and M2 respectively. The results obtained for all the fifteen (15) sampling locations were below 0.1 Bq/L recommended screening limit by WHO and others radiation regulatory bodies. The sachet water from the companies were contaminant free, therefore posing no cancer risk, even though the results were below the Screening limit, it is important to keep on testing and treating the water quality from time to time.

Keywords: Potassium-40; Risk; Cancer; Water Quality; Concentration

Abbreviations: M1: ADSU Sachet Water; M2: MUGULBU Water; M3: EL-HAM Water; M4: KWALI Water; M5: KHAIRAT Water; M6: YETTORE Water; M7: AMJAD Water; M8: AFAMA Water; M9: WHORA Water; M10: UKTEEMA Water; M11: KUDASON Water; M12: SANDY Water; M13: SAHAVA Water; M14: AMAS Water; M15: SHAMS Water; CERT: Centre fur Energy Research and Training; ABU: Ahmadu Bello University Zariac

Introduction

The naturally occurring radio nuclides originate in the earth's crust where Uranium and Potassium are widely distributed and detectable in all soils and rock (Onaja, 2014) [1]. Absolute ages of rock, minerals and meteorites are determined using decay of long-lived radioactive isotopes and accumulation of their stable decay product (Kossert, 2022) [2]. 40K and 137Cs are isotopes representing elements that are distinguished by slight differences in their chemical properties but that have different origins in the environment (Krolak,2010) [3]. 40K Krolak (2010) [3] is a natural isotope whose percentage in total Potassium content is estimated at 0.0119. Exposure to ionizing radiation from natural sources is a continuous and unavoidable feature of life on earth. The greatest contribution to mankind exposure comes from natural background radiation and the worldwide (Yadav, 2012) [4]. 40K occurs extensively in nature and is found in minerals, ores, soils, rocks, sand, rivers. The decayed residues of animals and plants also contain this radioisotope (Yadav, 2012) [4].

Materials and Methods

Study Area

Mubi located in Adamawa State, Nigeria (approx. 100031 - 10030N, 13°l01 - l3°301E), is a historic commercial hub founded by Fali and Gude peasants, later becoming a German base (1902) and British colonial outpost. It is now major Centre for commerce and Agriculture, divided into Mubi North and South.

Sampling

A total of fifteen (15) sachets of water samples were collected from both Mubi North and South local Government metropolises. The water samples were collected in 1Liter containers and were acidified with nitric acid (HNO^3) to prevent any loss by absorption of the radio nuclides around the container walls and reduced growth of microorganisms.

Sample Preparation

l00ml of water sample was mixed with 5ml of concentrated nitric acid in a 250ml conical flask. It was heated in a hot plate till the volume was reduced to 10ml. The hot solution was filtered into 100ml volumetric flask and diluted up to the mark. This procedure was repeated for all the water samples from each of the companies Yadav [4].

Estimation of Radioactivity of K-40

The standard method we applied to find out the concentration of K-40 in the soil and water samples that is, for potassium, the peak at 1.46MeV was used for analysis. The detector system coupled with 3" x 3" NaI crystal with 1024 channels were used for the process of measurement Yadav [4].

The expression for the cancer risk is given by:

Cancer risk = Concentration (Bq/L) x dose coefficient (Sv/Bq) x ingestion rate (L/YJ x risk factor (risk/Sv) (Yadav, 2012) [4].

Whereby

Dose coefficient (Sv/Bq) = 0.0000000062

Ingestion rate (L/Y) = 730

Risk factor (Risk/Sv) = 0.05

Results and Discussion

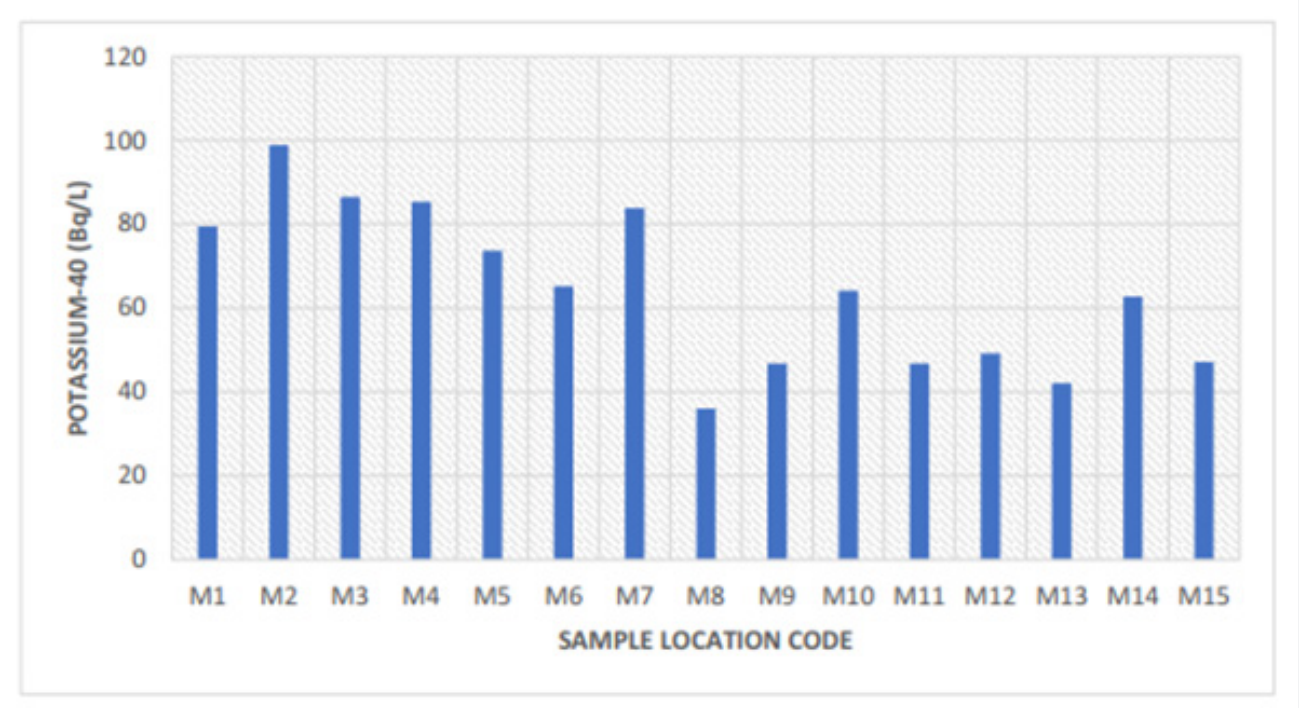

Figure 1: Chart showing Samples code and K-40 Concentration.

The figure above showed that sachet table water coded M2 has the highest bar, meaning has the highest contamination of K-40, while M8 has the shortest bar, which implied lowest activity concentration.

Table 1: Samples collection with activity concentration and cancer risks.

NO	SAMPLE ID	K-40 (Bq/L)	CANCER RISKS (RISK/YEAR)
1	MI	79.47	0.000018
2	M2	98.91	0.000022
3	M3	86.47	0.00002
4	M4	85.38	0.000019
5	MS	73.72	0.000017
6	M6	65.21	0.000015
7	M7	83.86	0.000019

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8	M8	36.08	0.0000082
9	M9	46.85	0.000011
10	MI0	64.15	0.000015
11	M11	46.84	0.000011
12	M12	49.23	0.000011
13	M13	42.13	0.0000095
14	M14	62.71	0.000014
15	M15	47.14	0.000011

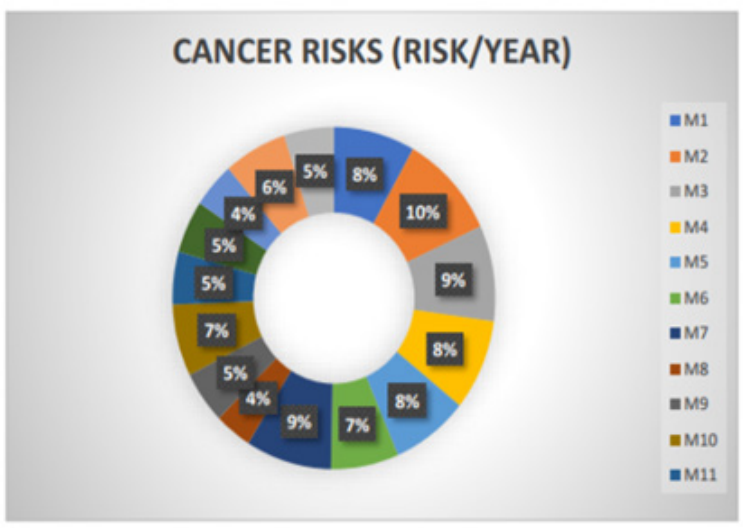

Figure 2: Pie chart Showing percentage of Cancer Risks.

The figure above showed that the chance of cancer risk fur Mubi dwellers consuming the mentioned sachets water is 10 out of 100, which is very low, therefore the water is good for consumption and for other domestic activities.

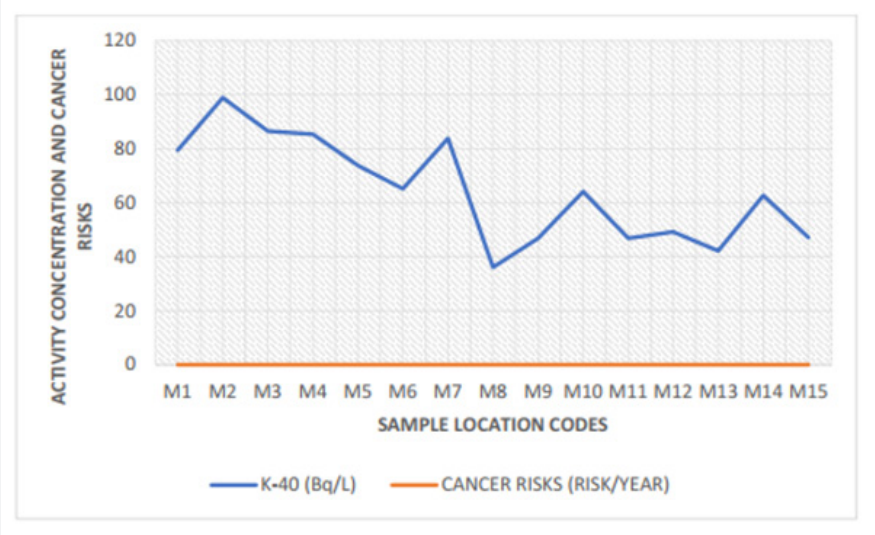

Figure 3: Line Chart showing Sachet water and Activity concentration.

The key from the figure above showed that the cancer risk for sachets table water for this research was insignificant, therefore pose no detrimental health challenges to the people consuming it.

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The table above showed that sachet table coded M2 recorded the highest Potassium-40 concentration, and the highest cancer risk, while M8 has the lowest K-40 concentration with least cancer risk (Table 1). The fluctuations of the results showed different concentration of K -40 in each of the sample's brand; all the results were below screening limit (Figures 1-3).

Conclusion

The results obtained for both activity concentration and cancer risk were below the screening limit, therefore consuming the water will pose detriment effect, even though the values were low, morning the quality of the water from time to time is very important.

Acknowledgement

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Conflict of Interest

The author does not have any conflict of interest.

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