Uranium content measurement in drinking water for Some region in Sudan using Laser Flourometry Technique

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Abstract: This study aimed to assess Uranium content measurement in drinking water for some regions in Sudan using Laser Flourometry Technique.Water samples were collected from different region in Sudan in Sudan for the time interval from Feb. to Dec. 2008.The sources of these samples comprise dug wells, tube wells and hand pumps. Uranium is determined using laser fluorometry technique, while as for trace elements in soil and plant samples Inductive Coupled Plasma (ICP) was used.The values of Uranium activity in the water samples varies from 1.7484 Bq/L to 0.1364 Bq/L. These values are compared with safe limit values recommended for drinking water, and compared with quantity of radiation background for each area, in order to see if some correlation exists between the concentration of uranium and radiation background. The calculated values of Uranium activity in the water samples from different areas of state in Sudan ranged from 1.7484 Bq/L to 0.1364 Bq/L .
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1. Introduction

Natural radiation depends on location, altitude and geochemical effects that cause enhanced levels of terrestrial radiation is never been absent and has been irradiating all forms of life since the beginning of creation.

Great interest in the study of NORM external and internal hazards to human beings have been noticed during the exploration of uranium and uranium bearing rocks (Merdanoglu and Altinsoy, 2006.UNSCEAR, 1993. UNSCEAR, 2000. Radhakrishna, 1996. Quindo´s, 1994.)

. 235U, 238U and 232Th series and natural 40K occur at trace levels in ground formations because of radioactive decay and depend upon the local geology and geography of the region.

In addition to the table, 222Rn gas and its radioactive progeny, which has a half-life of 3.8 days with decay product of radium-226 and ultimately of uranium-238. Radon can accumulate in enclosed areas such as underground mines and houses. When inhaled into the lungs, alpha particles emitted by short-lived decay products of radon can damage cellular DNA. In addition, other organs, including the kidney, the stomach and the bone marrow, may receive 222Rn doses(NRC 2011 , 2004, Abdul-Majid and Abulfaraj,1992, Al Hamarneh et al 2003.,Tawfik et al 1987).

Uranium is a naturally occurring long-lived radionuclide, which is known for both its radio-toxicity and chemical toxicity. In order to assess its effect to public health, knowledge is necessary about the distribution and transfer of U in the soil-water plant system, especially in agricultural fields. Uranium and other heavy metal impurities may accumulate in the soil Rothbaum et al, 1979.

and be leached into ground and surface water where they can be taken up by plants and transferred into the food chain. Generally, the occurrence of radionuclides in the underground water is mainly due to the leaching of the salts from the bed-rocks. The concentration of uranium in water depends on several factors. These include the uranium concentration in the aquifer rock, the partial pressure of carbon dioxide, and the presence of oxygen and complexion agents in the aquifer. The characteristics of water that mainly determine its capacity to dissolve, carry or deposit elements are its pH, temperature, redox potential, concentration and properties of dissolved salts, flow rate, and residence time Shabana and Al-Hobaib A,1999.

The health effects and risk of uranium can be divided into radiological risk of uranium isotopes and the chemical risk as a toxic heavy metal. US Environmental Protection Agency (EPA) has classified uranium as a confirmed human carcinogen

(group A). EPA has suggested that only zero tolerance is a safe acceptable limit for the carcinogenic risk from uranium and has finalized realistic regulation levels as maximum contaminant level (MCL) The "minimal risk" level for intermediate-duration ingestion proposed by the EPA ATSDR/EPA 1999.is an oral uptake of 2 μg of uranium per kg body weight/day.

Uranium, a silver colored heavy metal in its form, is natural, ubiquitous and radioactive. It is widespread occurrence, being found in minute quantities in all rocks, sand and soil. The natural radioactivity of waters is due to the activity transfer from bedrocks and soil. Thus, the activity concentrations found in water depend on the concentrations encountered in the rocks with where the water comes in contact. Surface water and especially ground water plays a role in the migration and redistribution of the nuclides in the earth's crust. Concentration of uranium and its progeny products in water are influenced by the chemical and physical characteristics of the aquifers and by the uranium content of geological formation involved UNSCEAR, 1966, UNSCEAR, 1972.

Radioactive nuclides in water enter the human body mainly through food or drinking water, inhalation being of importance only for the daughter products of 222Rn. High vales of uranium in drinking water and foodstuffs may lead to harmful effects in human beings. However, in natural water, uranium concentrations greater than 100ppb are quite rare, and have generally been found in aquifers containing uranium mineralization. An exposure of about 0.1mg/kg of a body weight of soluble natural uranium results in transient chemical damage to the kidneys (USEPA), 1991

As concluded that nephrotoxic effects are the dominating factor in setting a standard for uranium. Radiotoxicity also arises from irradiation of bone surfaces and red bone marrow by alpha particles emitted by uranium.

In this work, we directed our efforts to assess Uranium content measurement in drinking water for some region in Sudan using Laser Flourometry Technique

2. Material and Methods

A total of nine samples of water from different areas of Sudan was collected, the measurements made by the UA-3 instrument are based on the fluorescence of an uranyle complex formed by addition of a reagent to a sample during analysis. Ultraviolet excitation is provided by a small nitrogen laser (at λ = 337 nm), uranyle salt emits a green luminescence that can be measured quantitatively by suitable photodetector. To overcome the effect of interference materials that present in the samples, internal standard method is used during the analysis Singh et al, 1994.

For surface waters which are seen to be reasonably free of suspended matter, there is no sample preparation, and analysis can be done directly. If there is obvious suspended material, filter to allow the sediment to settle for few hours and decant carefully the clear water for sample analysis.

Fluran contain a buffer solution which should maintain the sample at pH = 7 during analysis. This pH value appears to be the best value for both the optimum fluorescence and making of interference.

Ground water from springs wells or drill holes (or waste from facilities) may contain much higher levels of dissolved solids, sufficient in some cases to inhabit direct measurements on the addition of fluran. White precipitates sometimes occur due to the formation of insoluble calcium or magnesium phosphate. Dilution is impractical. The precipitate can usually be dissolved by addition a drop or two of 85% orthophosphoric acid.

For determination of uranium concentration in the sample the following steps were carried out:

Five milliliter of the sample was taken into quartz cell.

Two ml of FLURAN (sodium pyrophosphate, sodium dihydrogen phosphate) was added to the sample.

The photomultiplier tube (PMT) was switched on to allow interaction of LASER beam with the sample.

The meter deflection (R1) was observed and recorded. The reading is corresponded to the uranium concentration in the sample.

The step above were repeated for uranium standard, where (R2) corresponds to the concentration of uranium in standard.

The uranium concentration in the water was calculated using the equation:

$$U_s = U_{st.} \frac{R_1}{R_2}$$

Where, Us is the concentration of uranium in the sample

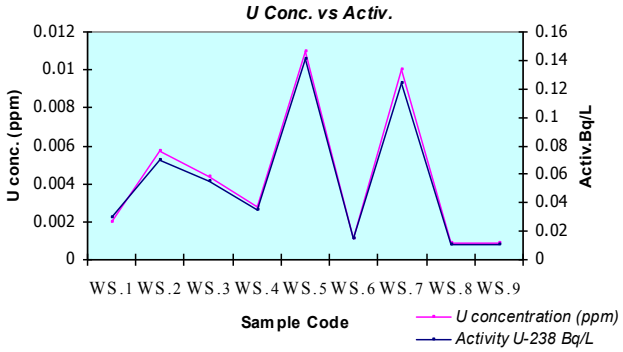
Ust. is the uranium standard concentration. WHO Guidelines for Drinking-water Quality (2005),

3. Results

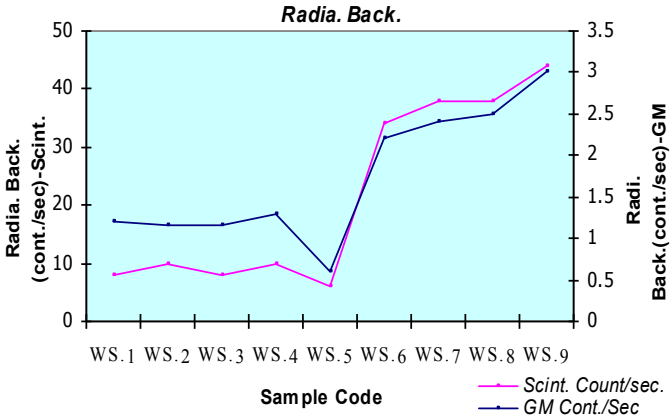
Table 1 presents the Samples results in kBq/kg , Figures (1 and 2) show the correlation between uranium concentration and radiation background at the same point. And figures (3 and 4) illustrate no relation between radiation background and uranium concentration.

Table 1 presents the Samples results in kBq/kg

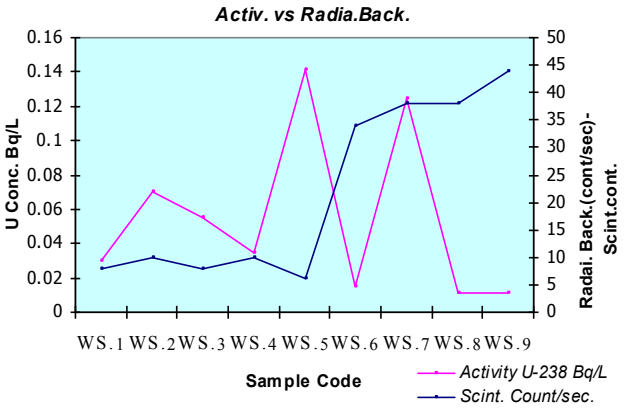
Samples results in kBq/kg						
Code	Ra-226	Pb-214	Pb-212	Ac-228	K-40	Counts/sec (at 1m)
MI008	0.13	0.12	0.14	0.19	1.30	250/220
MI009	0.12	0.12	0.10	0.12	1.20	
MI011	0.05	0.05	0.03	0.03	0.16	110/100
MI012	0.17	0.16	0.14	0.16	0.75	400/320
MI013	0.23	0.18	0.24	0.30	1.10	500/460
MI015	0.05	0.08	0.08	0.13	0.64	
MI016	0.22	0.22	0.22	0.26	0.66	
MI017	0.26	0.25	0.32	0.37	0.95	
MI018	0.21	0.21	0.19	0.21	1.00	
MI019	0.14	0.11	0.14	0.16	0.61	210/200



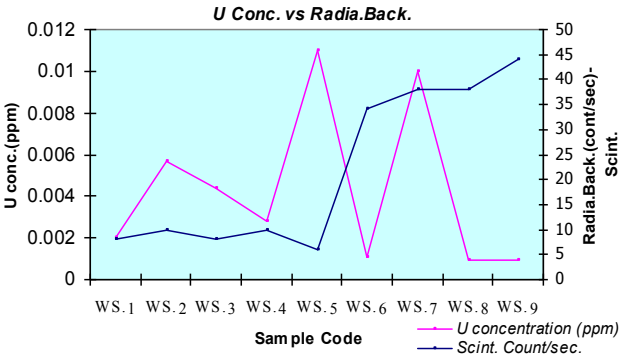
Fig(1)



Fig(fig(2)



Fig(3)



Fig(4)

4. Discussions

The elements of radiological assessment include the specific radionuclides released, their transport, bioaccumulation, & uptake by humans, doses resulting from the uptakes, & an estimation of the risk due to the dose National Council on Radiation Protection & Measurement, 1984 , National Council on Radiation Protection and Measurements, 1992.

Analysis results for soil revealed that the highest concentration element in Jew's mallow soil is Fe (154284.56 ppm) and the lowest concentration element is Br (75 ppm). In Gumbo's soil, the highest concentration element is Ti (2430189.58 ppm) and the lowest concentration element is Y (163.31 ppm). But in Berseem's soil the highest concentration element is Ti (1912390.23 ppm) and the lowest concentration element is Pb (149.45 ppm).Also in Watercress's soil the highest concentration element is Ti (1857374.04 ppm) and the lowest concentration element is Br (37.27 ppm). In Tuti Island soil the highest concentration element is Ti (1087147.51 ppm) and the lowest concentration element is Y (125 ppm). But in El-Burkul mountain soil the highest concentration element is Ti (575820.65 ppm) and the lowest concentration element is Br (133.86 ppm).

About the plants in northern the most concentration element to the Jew's mallow plant is Ca (134448.98 ppm), and the lowest concentration element is Mn (39.36 ppm). In Gumbo plant the highest concentration element is Fe (303417.72 ppm), and the lowest concentration element is Mn (15.86 ppm). With Beam plant the highest concentration element is K (273037.97 ppm), and the lowest concentration element is Mn (69.47 ppm). And about Watercress's plant the most concentration element found was K (435569.62 ppm), and the lowest concentration element is Mn (23.35 ppm).

Tuti Island plants the most element concentration found in Berseem plant were Ca (132685.71 ppm), and the lowest concentration element in Mn (17.03 ppm). In watercress's plant the highest concentration element is K (25696.20 ppm) and the lowest concentration element is Mn (19.53 ppm).

It concluded that Using Laser Flourometry Technique for water samples from the study area gives a reading ranged from1.7484 Bq/L to 0.1364 Bq/L concentrations in the water sample.

Uranium concentration in the water sample was found to be in comparison with previous study ADWG 1996.

It will be very useful to perform the same study in other areas in Sudan with similar geologic patterns in order to have a complement and complete conclusion for the findings in our study.

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