International Journal of
Health Systems and Medical Sciences

ISSN: 2833-7433
Volume 2 | No 8 | Aug -2023

Effect of Radioactivity of Drinking Water on Human Health and its Scintillation Gamma Spectrometric Assessment

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Abstract: Potability properties of underground drinking water were evaluated analytically and medically based on the amount of Rn222 isotope in the water. The mineral composition of the selected drinking water object was also determined using electrochemical and chemical analysis methods.

Keywords: Radioactivity, water, human health, gamma spectrometry, ionometry, titrimetry, medicine.

The presence of various mineral and nutritional substances in the products of agricultural crops, which constitute the main reserve of food products, largely depends on the soil in which they are grown and the surface and underground soil used for irrigation. depends on the influence of water and partly environmental objects. As an object of analysis, samples of underground well water used for irrigation purposes and for drinking and treatment-prophylactic purposes in Ko'shrabot district of Samarkand region are the main object of our research. Its subject consists of product samples taken for analysis, water samples selected for analysis, reagents and equipment used in chemical, electrochemical and optical analysis processes.

Today, in addition to the cultivation of agricultural products, one of the first-level tasks is to assess the potability of surface and underground water. Therefore, in this work, we were interested in the presence of various harmful ingredients in addition to mineral substances in underground and surface drinking water. One of the most important requirements for drinking water is whether it contains radioactive substances and how, due to their various degrees of decay, new isotopes with heavy and radioactive properties are formed, which lead to more harmful consequences. scientific-research works aimed at directions were carried out [1,2,4,5,6].

Radon (Rn^{222}) is a natural source of radioactivity for groundwater. Due to the heterogeneous distribution of uranium and radium, flow patterns, and different geochemical conditions, radon levels in groundwater are difficult to estimate. High radon concentrations in groundwater are not always associated with high uranium content in rock, as groundwater with high uranium content is found in areas with low or moderate uranium concentration in rock. This paper describes a methodology for the analysis of areas of high concentration of Rn^{222} in groundwater at a general scale, approximately 185×145 km^2. The methodology is based on multivariate statistical analyses, including principal component analysis and regression analysis, and examines uranium (U) factors in geology, land use, topography, and rock composition.

Radon from groundwater used for domestic purposes is one of the sources of natural radioactivity in indoor air. Due to the occurrence of uranium minerals, hydrogeochemical conditions, tectonic structures, and hydraulic chains, the path of radon from rock to groundwater is unpredictable. High radon potential in bedrock is not always associated with high radon levels in groundwater. In addition, inhaled radon from household use can also increase indoor radon exposure.

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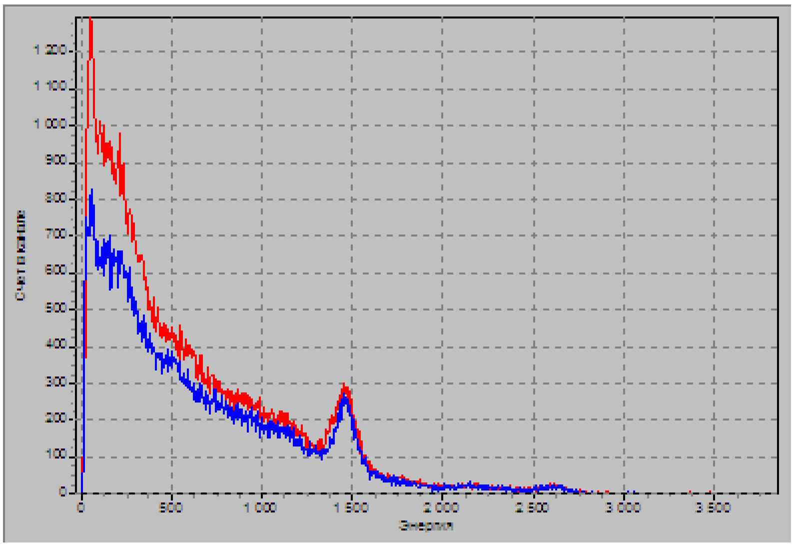
The results of the assessment of the mineral content of the water samples evaluated for their radioactivity properties are presented in the following tables. The pH values of the examined water bodies were determined ionometrically using a hydrogen-selective glass membrane indicator electrode and Ag/AgCl comparison electrodes.

Concentrations of ions such as calcium, sodium, potassium, and nitrate in natural water were determined using ionometric analysis methods, which have advantages over other electrochemical and chemical analysis methods in terms of accuracy, sensitivity, and selectivity, and are based on the use of ion selective electrodes. Ag/AgCl and calomel electrodes were used as comparison or auxiliary electrodes. Ion-selective electrodes used for the determination of potassium and calcium are ion-conducting electrodes with a polyvinyl chloride membrane. We used chemical methods for determining chloride and sulfate ions.

This picture shows the gamma spectrum of the underground water of the village of Koshrabot district (natural background in green, ^{222}Rn in red).



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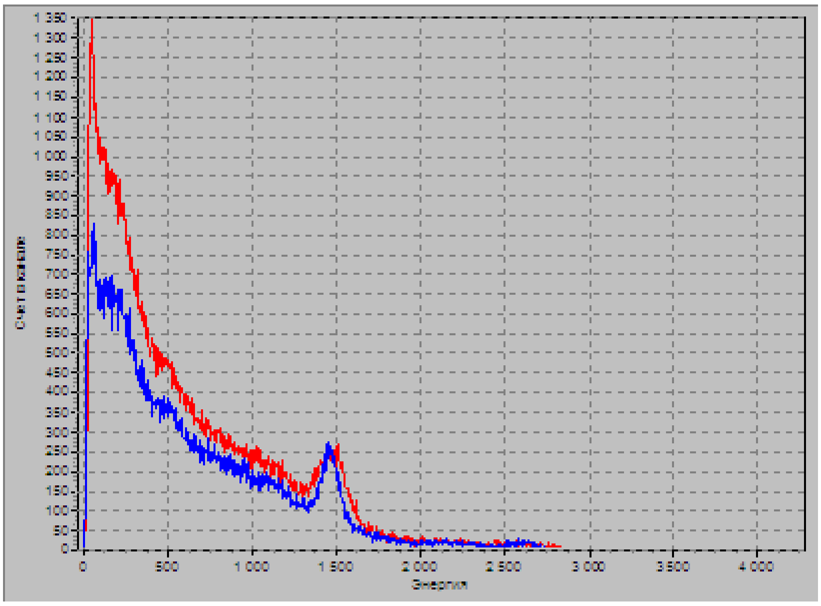
The result of the gamma spectrum of Rn^{222} in the above image can be calculated as follows:

$$\mathbf{A=A_{Ra}+3,7A_{Th} + 0,0146A_{K}= 2,7576+ (3,7\cdot 2,0193) + (0,0146\cdot 18,82)=10,51}$$

The next picture below shows the gamma spectrum of the groundwater of the neighboring village, which is considered the 2nd analysis object of the Koshrabot district (natural background in green, ^{222}Rn in red).



The result of the gamma spectrum of Rn^{222} in the above image can be calculated as follows:

$$A=A_{Ra}+3,7A_{Th}+0,0146A_K=2,6404+(3,7\cdot 1,952)+(0,0146\cdot 17,622)=10,12$$

During the evaluation of radioactivity characteristics of underground and surface waters, we determined their chemical composition and evaluated the quantitative parameters that evaluate the suitability of drinking water based on the results obtained from different standards and equipment of the analysis.

The effect of radiation on the human body was studied. Based on the results of the study, the following conclusions can be drawn:

1. Changes in future generations due to genetic mutation;
2. Various changes in the fetus due to irradiation in mothers during pregnancy;
3. Excessive exposure to the permissible amount of radiation causes anemia in the human body.
4. It depends on the direct death of a person as a result of excess radioactive radiation.

Not only humans, but all living things on Earth always receive a certain amount of radiation. There are various radioactive isotopes in the composition of surface and underground water in the productive part of the earth up to a certain depth, and also in the composition of food and agricultural products created by means of them. But the extent to which people can take them and keep them in their body depends to a large extent on the way people eat.

"A certain level of daily radiation does little harm to them. On the contrary, the medicinal capsules taken to combat it are more harmful to health." said Geralt Epstein. In order to protect the population and the environment from the harmful effects of radioactive radiation, the government of our country has adopted laws on radiation safety in many decisions and legal documents. Ensuring radiation safety in them requires an in-depth study of the mechanism of formation of radioactive radiation and its impact on the living world.

The increase in the amount of radioactive elements in underground water is related to geological conditions as a result of long-term observations. Usually, when determining the radioactivity of natural waters, the amount of radium and radon in the water is determined. Therefore, the natural radioactive isotopes present in the water will pass to the human body over time and become a source of internal radiation depending on the half-life of the isotopes. Water flows through different rocks, through minerals, through different places. Radioactive isotopes are washed into waters from soils, rocks, or other radioactive waste burial sites. Under certain conditions, the amount of radioactive isotopes in water may increase. This leads to the increase of radioactive isotopes in the human body and their excessive radiation. Excessive radiation of people beyond the safe limit causes the development of various life-threatening pathological processes in the body.

The accumulation of radionuclides in the human body causes them to radiate from the inside. When the amount of radiation received by people exceeds the safe limit, it can cause pathological processes in healthy people - life-threatening diseases such as birth defects, impotence, skin diseases, cancer. Therefore, constant monitoring of radon content in water and air, its migration, search for ways to reduce it, and its application are urgent problems from a radioecological point of view.

The dissolution of radon in water depends on the temperature of water, and the dissolution of radon in water decreases as the temperature rises. The dissolution of radon in water also depends on the chemical composition of the water. The more minerals in the water, the less radon dissolves. Radon also dissolves well in organic liquids. For example, it dissolves well in olive oil and oily water. For treatment purposes, various processes such as radon baths and radon inhalation are also used, especially in chronic diseases. The therapeutic effect in treatment is related to the radiation effect of radon. It should not exceed 60-80 bq/1 according to the permitted norm in drinking water [3].

Constant monitoring of changes in the amount of various substances in environmental objects at the standard level is one of the urgent problems of modern medicine and analytical chemistry. It is not without reason that their achievements in the field of environmental protection, creation of scientifically based methods, tools and modern sensors of analytical control are recognized by scientists of the developed countries of the world.

The amount of radon-^{222} isotope up to the permissible standard level also has useful properties. This aspect of it is used in medicine to restore human health and it is called radiotherapy method. Radon baths, rich in natural and artificial radon waters, are currently one of the most common methods of treatment, installed in special sanatoriums and central recreation centers. They are made not only by baths, but also by showers and drinking. As a result, the process of microcirculation in the skin improves, the work of the heart normalizes, arterial pressure is coordinated, the activity of the immune system increases, the anti-cold effect increases, the serum and morphological composition of the blood normalizes, the process of tissue regeneration is stimulated, and it helps to normalize the main metabolic effects.

The following tables present the results of the study of the mineral composition of groundwater samples in the villages of Koshrabot district.

Samples of rural groundwater in Koshrabot district

results of determination of mineral composition

n=3, $\overline{p}$ =0.95, $\Delta\overline{X}t_{pf}$=4.30

№	Specified quantities	Units of measurement	$\overline{X}$	S	Sr, %	$\Delta\overline{X}$
1	pH	mol/l	7,40	0,0267	0,3615	0,0665
2	Quruq qoldiq	mg/l	0.03	0,0002	4,2402	0,0003
3	Ca^{2+}	mg/l	1.12	0,0027	0,2412	0,0067
4	Mg^{2+}	mg/l	1.23	0,0027	0,2246	0,0068
5	Na+	mg/l	2.32	0,0020	0,0884	0,0051
6	K^{+}	mg/l	2.40	0.0099	0,0941	0.0247
7	Cl^{-}	mg/l	80.2	0,7478	0,9325	1,8588
8	SO_4^{2-}	mg/l	108	0,0157	0,0152	0,0409
9	General Hardness	mg-ekv/l	5,60			

It can be seen that the total hardness of the groundwater of the studied village exceeds the standard level for drinking water, and the amount of dry residue is 0.03 mg/l, which is much less than the total dry residue of most waters. The fact that the amount of chloride and sulfates in drinking water is close to the standard level for such waters proves the consistency of the measurement results several times. When the results of the quantitative analysis are evaluated metrologically, the relative standard deviation value for the ions is generally in the range of 0.0152% to 0.2412%, and the confidence interval values of the results are in the range of 0.0409 to 0.0067. proves correct.

Koshrabot district of Samarkand region was selected as an analytical sample from underground waters, and it was adapted to the standards set for them. When checking the presence of individual components, one-time inspection samples are taken. It is advisable to check surface water at least once a month. The sampler must meet the special requirements of instruments and devices.

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