NEW DATA ON NATURAL RADIOACTIVITY OF SOME ROMANIAN FRESH WATER SOURCES

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INTRODUCTION

As water is an important factor of transfer of the natural radioelements towards the human organism, the main objective of the present research is to measure the natural radioactive content of fresh water in the Moldova region. The natural radioelements of utmost interest in finding out the radioactive water content are uranium,thorium,radium-226 and potassium-40.

MATERIALS AND METHODS

During 1982-1989 there were taken, from the territory of Moldova, 767 water samples of which 348 originated from ground water sources (individual or catchments) and 419 from surface waters (1). Between 1990 and 1994 we went on with the measure of the natural radioactive content of the fresh water in Moldova region (740 samples). We wanted to have data on the possibly changing values as a result of the new water sources findings and of the modifications in water processing stations. In selecting the sampling points, i.e. wells and micropower stations, the direction of a ground water table was followed, so that the differences in value should be due only to dissolved radioelements. As far as the potable water originating in the surface sources is concerned, the samples were taken from the central municipal and town water supply systems. The taking of samples and their analysis were carried out in conformity with the current standards (1).

RESULTS AND DISCUSSION

The variation domains with water supply sources originating from surface layers and the ground water are presented in Table 1.

Table 1. Activity concentration of natural radionuclides in drinking water samples (mBq l^{-1})

Radionuclide	Water source		AMAC *
	Ground water	Surface water	
^{238}U	0.6 - 37.2	0.36 - 18.0	257
^{232}Th	0.05- 9.3	0.035- 8.0	40
^{226}Ra	1.1 - 21.0	0.75 - 9.5	88
^{40}K	15.0 -720.0	58.0 -670.0	13420

* AMAC - Admitted Maximum Activity Concentration STAS 1342-91

On should remark that neither of the analysed samples exceeded the specific activity admitted in Romania for fresh water, in any of the natural radiolements under investigation.The mean activity concentrations of natural radionuclides in fresh water samples, for the three time periods of survey,are shown in Table 2.

Table 2. Average activity concentrations (mBq l^{-1}) of natural radioactivity in drinking water samples (according to water source type)

Number of samples by water source and investigation period		Radionuclide			
Ground	Surface	^{238}U	^{232}Th	^{226}Ra	^{40}K
(1982-1985)					
I* 39	2	10.4±1.8	7.8±1.3	10.4±1.9	
II 102	155	3.9±0.8	1.3±0.2	4.8±1.2	140.4±11.1
III 17	44	<2.2	<0.22	<1.8	81.1± 7.4
(1986-1989)					
I 47	8	12.6±3.8	7.2±1.2	8.1±1.0	
II 109	157	4.0±1.4	1.5±0.3	3.9±1.4	283.2±120
III 34	53	0.6±0.2	0.06±0.02	1.2±0.3	112.2± 64
(1990-1994)					
I 66	15	11.7±3.1	7.5±1.2	8.9±1.3	
II 135	262	3.9±1.1	1.4±0.2	4.3±1.3	140.5± 22
III 119	143	0.7±0.2	0.1±0.04	0.8±0.2	52.9± 10

* - Water category

We succeeded in evidencing three categories of fresh water, according to the average content of natural radioelements, such as in Table 2.
1st category-fresh water with a high natural radioactive content, with a tenth order mean.
2nd category-fresh water with an average natural radioactive content, with unitary order mean.
3rd category-fresh water with a reduced radioactive content,with a subunitary mean.
The highest values for U, Th and Ra were mostly found in fresh water originating from ground table,about 23 % of samples being included in the 1st category. The fresh water originating from surface layers has a dimineshed natural radioelements content, due to treatment operations (floculation,settling,filtering, etc), 71% of the samples belonging to the category of average natural radioelements content and 29% to the 3rd category with the lowest natural radioactive content. During 1990-1994, the mean values for the four radionuclides were not by far different from those of 1982-1989, but the samples percentage distribution in the 2nd and 3rd categories is different. This may be explained by the rock radioactivity that the ground water passes through (2,3). In the case of the surface waters, it is possible that it might be due to the water processing improvement. The thorium concentration of drinking water is smaller than that in uranium, probably because of the much lower solubility of thorium in water. For each of the three categories the ingestion of natural radioelements per capita was assessed, considering a daily consumption of 2 litres (Table 3). We have obtained values which ranged within those reported by literature for the areas with

normal radiation background but higher than the average (4,5).

Table 3. The annual ingestion of natural radionuclides (Bq y^{-1})

Radionuclide	Drinking water <10 year old	Drinking water adults	Dietary intake in Moldova	Dietary intake in areas of "normal" background
^{238}U average	0.8	2.04	7.5	5
range	0.16-3.46	0.42-8.82	6.2-11.2	-
^{232}Th average	0.29	0.73	2.2	2
range	0.01-1.98	0.04-5.04	1.6- 3.4	-
^{226}Ra average	0.83	2.12	14.1	15
range	0.33-2.22	0.84-5.70	12.4-16.2	-

The contribution of drinking water to the total intake by ingestion varies over a wide range. Comparing the assessment values with those for food ingestion one can notice that natural radioactivity intake through water is much smaller (6).

CONCLUSIONS

1. The concentrations of uranium, thorium, radium and potassium activity in potable water in Moldova are lower than the admitted specific activity for the areas with a "normal" background.

2. Fresh water originating from ground water table has a higher natural radioelements content than that originating from surface water.

3. During 1990-1994 period the mean values for the four radionuclides were not different from the other periods, but water processing improvement and the finding of newer sources, probably influence the samples percentage distribution in those three categories.

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