Table 3
Results of alpha-specrtometry analyses of samples from Black sea (2004) [Bq/kg]

Sampling place	Sample type	U-234	U-235
Galata – 6 miles to the east	*Mytilus galloprovincialis*	6 ± 1	0,4 ± 0,1
Kaliakra	*Mytilus galloprovincialis*	7 ± 1	0,5 ± 0,1
Varna – fishing beach	*Chlorophyta*	7 ± 1	0,4 ± 0,1
Galata	*Rapana venosa*	1 ± 0,2	< 0,1

Sampling place	Sample type	U-238
Galata – 6 miles to the east	*Mytilus galloprovincialis*	4 ± 1
Kaliakra	*Mytilus galloprovincialis*	5 ± 1
Varna – fishing beach	*Chlorophyta*	5 ± 1
Galata	*Rapana venosa*	1,4 ± 0,2

DISTRIBUTION OF ^{3}H IN OBJECTS FROM BR "SREBARNA" AND SURFACE WATERS FROM NORTH AND SOUTH BULGARIA

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ABSTRACT

By reason of the big radiation-hygienic significance of tritium for the individual its specific activity is determined in soils, plants (agricultural and aquatic) and water from BR"Srebarna" and surface waters from North and South Bulgaria. The determined levels of specific activity are low, due to global cycling tritium, and show the lack of local tritium contamination.

INTRODUCTION

The tritium in the environment is produced by the interaction of cosmic rays with nucleus of chemical elements in the atmosphere, the nuclear bomb test, the operation of nuclear reactors and nuclear fuel reprocessing plants. Tritium is one of the more important radionuclides for doze assessment, characterizing and determining the radiation situation in the regions around nuclear fuel cycle

industries. As an isotope of hydrogen, the tritium is includes in many organic compounds, as well as in genetic-information macromolecules. The beta-decay of tritium leads to disrupt of the molecular structure and the intermolecular connection by effect of ionizing radiation of beta-particles as well as the transformation of tritium to isotope of helium.
By these reasons, the investigation of specifics of the behaviour of tritium in the environment and the pathways for incoming in human organisms is an important purpose, as well as his high migration mobility motivates the necessity of long-term dynamic monitoring.
The purpose of this paper is investigation of the distribution of "free" tritium in elements of ecosystem of the Biospheric reserve "Srebarna" and surface water from North and South Bulgaria.

MATERIAL AND METHODS

The specific activity of tritium in elements of ecosystem of the Biospheric reserve "Srebarna" and his restricted area was determined in period 1998-2000 years. Twice annual (in spring and autumn) was performed sampling for analysis water, water growing plants, /wodna tchuma (*Egeria densa)*, wodna leshta (Lemna minor), drebna mehurka (*Ultricularia vulgaris)* and rogolistnik (*Ceratophyllum demersum)/*, soil, agriculture plants and products (wheat, maize, sunflower, bean, potatoes and lucerne), virgin-soil grass and reed *(*Phragmites astralis). In the next years, single samples of surface water from Northern and Southern Bulgaria have been taken.
The specific activity of tritium in biological material and soil was determinate as free water, obtained from low-temperature vacuum distillation; water samples were distilled after filtration by routine procedure. The next step of sample preparation for tritium analysis includes electrolysis isotope enrichment, with mean isotope enrichment factor (6.25 ± 0.35) for the system applied.
The activity of tritium in enriched samples was determinate on LCC Beckman LS 9800 with liquid scintillation cocktail Ultima Gold LLT (8 ml enriched water+10 ml cocktail) and time of measurement for each sample 500 min (5 cycles, each 5x20 min). The results obtained for specific activity of tritium was presents in Bq/l for all objects in this investigation.

RESULTS AND DISCUSSION

The annual mean specific activity of "free" tritium in soil and plants from region of the reserve "Srebarna" is between 3÷6 Bg/l for the 3 years of investigation (Table 1).

Table 1
The annual mean specific activity of ^{3}H (Bq/l water) in soil, agriculture plants and products, grass, water and water plants.

Sample	Site of sampling	1998 г	1999 г	2000 г
Soil, 0 – 10 cm	Southern lock	3 ± 1	5 ± 1	4 ± 1
Soil, 0 – 10 cm	Fazanarija	4 ± 1	4 ± 1	5 ± 2
Soil, 0 – 10 cm	Northern lock	4 ± 2	5 ± 2	4 ± 2
Maize, plants	Northern lock	4 ± 2	4 ± 2	4 ± 2
Maize, seed-grains	Northern lock	6 ± 2	4 ± 2	5 ± 2
Sunflower, plants	Northern lock	3 ± 1	3 ± 2	5 ± 2
Sunflower, seed-grains	Northern lock	4 ± 1	5 ± 2	4 ± 1
Wheat, plants	Northern lock	4 ± 2	3 ± 1	3 ± 1
Wheat, seed-grains	Northern lock	4 ± 1	4 ± 1	5 ± 2
Bean, seed-grains	West from museum	3 ± 1	3 ± 1	4 ± 2
Potatos, klubeni	West from museum	4 ± 1	3 ± 1	4 ± 2
Lucerne, plants	Northern lock	3 ± 1	5 ± 2	4 ± 1
Lucerne, plants	Southern lock	3 ± 1	4 ± 2	3 ± 2
Lucerne, plants	Fazanarija	4 ± 2	3 ± 2	4 ± 1
Grass, mixed	Northern lock	5 ± 2	4 ± 1	4 ± 2
Grass, mixed	Southern lock	3 ± 1	4 ± 2	3 ± 1
Reed	Southern lock	4 ± 2	3 ± 1	3 ± 2
Water	Northern lock	3 ± 1	4 ± 2	5 ± 1
Water	Southern lock	3 ± 1	4 ± 2	4 ± 2
Wodna tchuma	Southern lock	3 ± 2	3 ± 2	4 ± 1
Wodna leshta	Southern lock	3 ± 1	3 ± 1	4 ± 1
Mehurka	Southern lock	3 ± 1	4 ± 1	4 ± 2
Rogolistnik	Southern lock	3 ± 2	5 ± 2	5 ± 1

The lack of significant difference in concentration of the isotope between soil and plant may be connected with specifics of the behaviour and incoming. The tritium absorbed in soil as HTO following the same transport mechanism as normal water, distributes in soil profile and is accumulate from the plants. Besides the roots, the plants assimilates tritium from atmospheric moisture by surface of the leafs.
Simultaneously one significant part of soil HTO returns back to the atmosphere by evaporation from soil and leafs of the plants [Brudenell et al., 1997; Choi et al., 2005, 2007]. In the case of normal emission of tritium from generating sources between these processes is establish dynamic equilibrium, following to equal tritium concentration between in soil water, surface air and plants [Peterson, S., et al., 2000].

We did not specify differences in specific activity of tritium in water content of the different kinds of agriculture plants and between vegetative parts of plants (leafs and stems) and reproductive parts as seed-grains. Such a difference is establish after correction of specific activities with water content in these organs. In this case the tritium content in the seed-grains is in such order lower than in stems and leafs.

The results obtained for specific activity of ^{3}H in water from the lake and water plants (Table 1) confirms established relation [Murphy, 1984, 1993], that free water tritium in water plants is the same in the water.

In investigated water samples from Danube river (Kozloduj, Oriahovo, Belene, Svishtov and Silistra) the specific activity of ^{3}H vary from below the minimum detectable activity of the analyses (MDC=2.2 Bq/l) to 4.4 Bq/l. A comparison between the annual mean specific activity of HTO in Danube river for period 1998-2000 years (Table 1, Northern lock) with these for 2004-2007 year shows no difference between these data. An exception is only for warm channel of NPP "Kozloduj" in 2006 year - twice higher concentration of 9.0 Bq/l HTO.

Our results coincides with the data from [Villa and Manjon, 2004], who in water samples from Danube river, taken before outflow of the warm channel of NPP "Kozloduj (2003 year) determine specific activity of tritium 1.7–3.0 Bq/l, and from the warm channel–10.7 Bq/l.

The measurements of specific activity of tritium in surface water from other sites in Northern Bulgaria almost were below MDC and no significant dynamics was assessed. The same concentrations and dynamics were assessed in surface water from Southern Bulgaria, all results were below MDC with the only exception-water from Smolian lakes for 2004 year.

Conclusions

The results obtained shows that the level of tritium in elements of ekosystem of BR"Srebarna" and surface waters from Northern and Southern Bulgaria are in the limits of the typical tritium concentration for Central Europe and at this stage of investigation any tritium contamination in Bulgarian was not assessed.

The estimated annual mean specific activity of tritium is near to the average values in the environment, typical in the recent years for this globally dispersed radionuclide.

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