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210Po in Different Types of Teas

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As to their biological effect, ^{210}Pb and ^{210}Po - radionuclides are in a group of the most toxic ones. ^{210}Pb and its daughter products are mainly formed in the atmosphere following alpha-decay of ^{222}Rn . Then, together with dry and wet depositions, these products are precipitated on the soil surface and plant leaves, the latter being known as a plant part with an enhanced content of ^{210}Po [1]. As teas are globally the second only to drinking water as regards the volume consumed, the determination of ^{210}Po in teas is an actual problem.

The aim of the present work is to determine specific activity of ^{210}Po in different types of teas (black and green ones) and to estimate the effective annual radiation dose due to alpha-particles of ^{210}Po that enters the human organism when drinking tea.

The content of ^{210}Po in samples and aqueous extracts thereof was determined by alpha-spectrometry. The aqueous extracts were obtained by brewing 10 g of tea in 200 mL of boiling water for 10 minutes. The effective annual radiation dose was calculated assuming that the daily consumption was 10 g of dry tea. Experimental results and calculations are presented below.

Sample and country of origin; Specific radioactivity of ^{210}Po , Bq/kg; Fraction of extracted ^{210}Po , %; Effective annual radiation dose due to ^{210}Po , $\mu\text{Sv/yr}$

Black Teas

1. Princess Nuri (India); 7.3 ± 1.4 ; 17%; 5
2. Krasnodar (Russia); 12.7 ± 3.5 ; 1.5%; 1
3. Lisma (Ceylon); 16.7 ± 4.6 ; 4%; 2
4. Talk (India); 24.5 ± 4.8 ; 4%; 3
- Mean 15.3 ± 5.0 ; 6.6%; 3

Green Teas

5. Bird Ceylon Tea; 1.0 ± 0.3 ; 11%; 1
6. Jaf Tea (Ceylon); 3.2 ± 0.8 ; 55%; 9
7. Bird of Paradise; 3.5 ± 1.0 ; 18%; 3
8. Princess Java (China); 24.4 ± 4.2 ; 13%; 9
- Mean 8.0 ± 3.0 ; 24.3%; 6

Variations of ^{210}Po specific radioactivities in the samples under study may be attributed to varying ^{222}Rn concentrations in the surface air and different soil properties of the tea gardens. The mean ^{210}Po concentration in the samples of black tea is approximately two times that of in the samples of green tea, a possible reason for this being specific processing technologies for different types of tea. The raw material used for making green tea is treated with steam at temperatures from 95 to 100 °C [2], the weakly bounded Polonium species (e.g., those of in dust particles) being taken off the tea-leaf surface. When making black teas, there is no stage of steam treatment and ^{210}Po is not removed from the tea leaves. When making green tea in China, instead of steam treatment it is another procedure that is used, that of roasting the raw material at temperatures from 65 – 75 °C [2]. It cannot result in the removal of ^{210}Po from the leaf surface, and in the “Princess Java” green tea produced in China there are more radionuclide than there is in teas from Ceylon.

Green tea aqueous extracts are known to contain more organic substances than those ones from black teas [2]. The higher ^{210}Po content in extracts from green teas might be an indirect indication of a change of the physico-chemical state of the radionuclide during the stage of processing the tea raw material. It is possible that a certain part of the radionuclide transforms from the initial inorganic species into an organic one.

On drinking green teas, the maximum effective annual dose due to ^{210}Po , which is equal to 9 $\mu\text{Sv/yr}$, is comparable to the total annual dose due to ^{210}Pb , ^{210}Po , ^{228}Ra , and ^{226}Ra nuclides acquired from drinking water and is estimated to be 10 $\mu\text{Sv/yr}$ [3].

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- 2.Semenov V. M. The Newest Encyclopedia of Teas. Moscow, Nauka, 2006 (in Russian).
- 3.Commentaries to Radiation Security Norms (NRB-99-2009).Moscow, 2009 (in Russian).

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