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210Po in Different Types of Teas

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As to their biological effect, 210Pb and 210Po - radionuclides are in a group of the most toxic ones. 210Pb and its daughter products are mainly formed in the atmosphere following alpha-decay of 222Rn. 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 210Po [1]. As teas are globally the second only to drinking water as regards the volume consumed, the determination of 210Po in teas is an actual problem.
The aim of the present work is to determine specific activity of 210Po in different types of teas (black and green ones) and to estimate the effective annual radiation dose due to alpha-particles of 210Po that enters the human organism when drinking tea.
The content of 210Po 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 210Po,Bk/ kg; Fraction of extracted 210Po,%; Effective annual radiation dose due to 210Po, μSv/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 210Po specific radioactivities in the samples under study may be attributed to varying 222Rn concentrations in the surface air and different soil properties of the tea gardens. The mean 210Po 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 210Po 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 210Po 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 210Po 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 210Po, which is equal to 9 μSv/yr, is comparable to the total annual dose due to 210Pb, 210Po, 228Ra, and 226Ra nuclides acquired from drinking water and is estimated to be 10 μSv/yr [3].

1.Parfenov Y. D. Po-210 in the Environment and in the Human Organism. Atomic Energy Reviews, v. 12, 1974, p. 75 – 143.
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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