^{210}PO AND ^{210}PB CONCENTRATIONS IN BIOTA FROM THE TURKISH COAST OF THE BLACK SEA AND MARMARA SEA

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Abstract

This paper reports concentrations of ^{210}Po and ^{210}Pb radionuclides from the Turkish marine environment during the period of 1997-2000. According to the findings the natural radionuclide levels have increased in some Turkish biota samples. For this reason, besides assessing anthropogenic radionuclides, efforts should concentrate on the natural radionuclides, especially ^{210}Po.

Key-words:Radioactivity,biota,Black Sea,Marmara Sea

The natural radionuclide ^{210}Po is the main contributor to the radiation dose received by humans from seafood consumption. ^{210}Po and ^{210}Pb concentrations can be locally enhanced by effluents of non-nuclear contamination (use of artificial fertilizer, pesticide, detergent and fossil fuel) adding potential risks for human health. The levels of naturally-occurring ^{210}Po and ^{210}Pb radionuclides in water, biota and sediment samples from the Turkish marine environment have not yet been published in the scientific literature. However, the ^{210}Po concentrations in biota and sediment samples of Turkish sector of the Black Sea are given as ranges (1). On the other hand, there are many papers published on the anthropogenic radionuclides especially ^{137}Cs concentrations in Turkish marine environment after the Chernobyl accident (2-4). This paper reports the results of ^{210}Po and ^{210}Pb concentrations in macroalgae, sea snail, mussel and fish species collected from the Turkish coast of the Black Sea and Marmara Sea stations during the period 1997-2000.

Material and methods

The macroalgae species were: brown; *Cystoseira barbata*, and green; *Ulva lactuca* and *Enteromorpha linza*. The algae samples were washed in distilled water to remove sand and other contaminating materials. They were then dried at 85°C to constant weight and homogenized. Similar sized sea snail (*Rapana venosa*), mussel (*Mytillus galloprovincialis*) and fish species (shad, *Aloso bulgarica*; anchovy, *Engraulis encrasiocolus*; bass, *Dicentrarchus labrax*; whiting, *Merlangius euxinus*; Picarel, *Spicara maena maena*; horse mackerel, *Trachurus trachurus*; red mullet, *Mullus barbatus*; and bonito, *Sarda sarda*) were stored in an insulated ice box with a plastic bag and transferred to the laboratory. The samples were homogenized and analyses were made on wet tissues or of total soft parts of the samples.The measurements of ^{210}Po and ^{210}Pb were made using a standard method. The concentration of ^{210}Po in wet or dry samples were performed starting with a standard addition of a known activity of ^{209}Po as isotopic tracer. Samples were completely dissolved with mineral acids (HNO_3, HCl, H_2O_2). After evaporation, polonium was plated onto silver disc in 0.5 M HCl in presence of ascorbic acid. The silver discs were counted by silicon surface barrier detectors (Model BU-019-300-AS) connected to a PC. After the first deposition of ^{210}Po, the 0.5 M HCl was kept for five months to allow ^{210}Po in-growth from the ^{210}Pb contained in the solution.

Results and discussion

^{210}Po activity levels in brown algae are higher than those found in green algae species collected from Igneada, Kilyos, Amasra and Sinop stations (Table. 1). However, the ^{210}Po concentration in green algae is higher than brown algae at M.Eregli station. In the algae species tested, the highest concentration of ^{210}Po was detected at the Amasra station. ^{210}Pb concentrations in algae samples ranged between 0.51±0.33 and 17.47±1.23 Bq kg^{-1}. The highest concentration of ^{210}Pb was found in brown algae from the Igneada station. The ^{210}Po and ^{210}Pb concentrations in sea snail and mussel samples are given in Table 2. The results showed that the ^{210}Po concentration in soft parts of sea snail and mussel samples were the ranges 20.54±1.19 - 37.47±2.04 and 14.93±1.16 – 14.93±1.16 Bq kg^{-1} wet weight, respectively. However, the ^{210}Po levels in muscle tissue of the sea snails were detected to be about 1 Bq kg^{-1} wet weight. The highest ^{210}Pb concentrations in sea snail soft parts and mussel samples were found to be 5.24±0.39 and 4.62±0.26 Bg kg^{-1} at Persembe and Rize stations, respectively. The ^{210}Po and ^{210}Pb concentrations in fish species are given in Table 3. The levels of ^{210}Po concentration in anchovy were within the range of 27.5±1.2 and 53.4±1.7. The ^{210}Po activity in Marmara anchovy samples are significantly higher than that in Black Sea fish. ^{210}Po concentrations in red mullet and bonito were found to be 10.2±0.90 and 26.1±1.88 Bq kg^{-1} (wet weight), respectively. On the other hand, The ^{210}Po concentrations were lowest in shad, bass, whiting, picarel and horse mackerel. Topcuoglu *et al.* (4) investigated the ^{137}Cs in biota samples from the Turkish coast of the Black Sea and Marmara Sea during the period of 1997-1998. In that study it was found that the ^{137}Cs activity in algae and in soft parts of sea snail and mussels were below the lower limit of detection. At the same time, ^{137}Cs concentrations in fish species were found to be between <3 – 4.8 Bq kg^{-1} wet weight. These results confirm that the dominant contribution at the total radioactivity concentration in biota samples comes from natural radionuclides.

Acknowledgement. Thanks are due to IAEA for supporting part of this study under Contract No. 9712/R1/RO and Technical Cooperation Contract No RER/2/003 for Technical Assistance. We also thank to I.Akkurt for his valuable assistance.

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Table 1. ^{210}Po and ^{210}Pb concentrations (Bq kg^{-1} in dry weight) in macroalgae species ***NM, not measured***

Station	Collection date	Species	^{210}Po	^{210}Pb
Igneada	24.02.98	C.barbata	13.4±0.6	17.5±1.2
		U.lactuca	12.1±0.9	3.6±0.4
Kilyos	5.03.98	C.barbata	25.3±1.5	5.2±0.5
		E.linza	8.0±0.7	5.9±0.6
Amasra	11.11.97	C.barbata	54.7±2.6	11.6±0.8
		U.lactuca	42.3±1.6	11.3±0.6
Sinop	12.11.97	C.barbata	29.4±1.0	0.5±0.3
		U.lactuca	15.3±0.6	0.9±0.1
Persembe	13.11.97	C.barbata	8.3±0.4	2.5±0.1
M.Eregli	22.05.00	C.barbata	36.7±2.5	NM
		U.lactuca	46.5±3.7	NM

Table 2. ^{210}Po and ^{210}Pb concentrations(Bq kg^{-1} in wet weight) in sea snail and mussel species - ***NM, not measured***

Station	Collection date	Name and Tissue	^{210}Po	^{210}Pb
		Sea snail		
R.Feneri	5.03.98	Soft part	22.6±1.2	<0.2
		Muscle	0.9±0.2	<0.2
Amasra	11.11.97	Soft part	20.5±1.2	0.8±0.2
		Muscle	0.9±0.1	1.7±1.1
Persembe	13.11.97	Soft part	37.5±2.0	5.2±0.4
		Muscle	1.1±0.2	<0.3
Rize	26.06.98	Soft part	20.8±0.5	2.3±0.1
		Muscle	0.9±0.1	0.3±0.1
		Mussel		
Igneada	24.02.98	Soft part	18.1±1.1	_
Kilyos	5.03.98	□	18.1±1.0	_
R.Feneri	5.03.98	□	14.9±1.2	_
Amasra	11.11.98	□	18.4±0.7	3.7±0.5
Sinop	12.11.97	□	42.1±1.7	1.8±0.2
Rize	26.06.98	□	16.9±0.8	4.6±0.3
Sarköy	22.05.00	□	22.1±1.3	NM

Table 3. 210Po and 210Pb concentrations (Bq kg-1 in wet weight) in fish species ***NM not measured***

Stations	Collection Date	Name	^{210}Po	^{210}Pb
Igneada	24.02.98	Shad fish	1.4±0.1	<0.1
Amasra	10.11.97	Anchovy	32.0±1.9	_
Sinop	12.11.97	Anchovy	26.9±1.2	_
Persembe	13.11.97	Anchovy	27.5±1.2	_
	13.11.97	Bass fish	0.5±0.1	<0.1
Rize	26.06.98	Whiting fish	1.0±0.1	_
Ordu	17.03.99	Anchovy	46.3±3.4	2.2±0.1
	17.03.99	Whiting fish	5.4±0.4	<0.1
Tekirdag	25.05.00	Picarel fish	2.6±0.5	NM
	25.05.00	H. mackerel	2.0±0.2	NM
	25.05.00	Red mullet	10.2±0.9	NM
Marmara	30.10.00	Anchovy	53.4±1.7	NM
Ünye	30.10.00	Bonito	26.1±1.9	NM