

Activity Concentration of Polonium-210 in Different Aquatic System Fishes, Tamil Nadu

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ABSTRACT: This paper presents the distribution of ^{210}Po in the two ecosystems namely Koriayarriver (Trichy) and Athengarai estuary (Palk strait) of River Vaigai. The measurements were made on the ^{210}Po levels of muscle and bone of selected fishes collected from different ecosystem. Analyses of the results indicate that a muscle trend to accumulate ^{210}Po activity was higher level as compared to bone. The ^{210}Po activity in the fish muscle fell within the range of 10.52 to 45.3Bq Kg $^{-1}$ in KoriayarRiver and 20.8 to 181.9Bq Kg $^{-1}$ in Athengarai estuary. The Significance the results are discussed.



1. INTRODUCTION

All living organisms of the planet are exposed to the natural radiation, which is mainly due to the activity concentration radionuclides ^{232}Th , ^{238}U and their product of decay, in addition to the other natural radioactivity ^{40}K present in the earth crust. Natural radioactivity is wide spread in the earth's environment and it exists in various geological formations like soil, rock, plants, sand, water and air. Hence, humans should beware of their natural environment with regard to the radiation health effects. Some of the radiation health effects are chronic lung diseases, acute leucopenia, anemia and necrosis of the mouth. Many areas in the world such as Australia, Brazil, china, India, Iran, Japan, etc., possess high levels of natural radiation. In the recent years, studies on the high background radiation areas in the world have been of prime importance for risk estimation due to long term low-level whole body exposures to the public. The high radiation levels are due to the presence of large quantities of naturally occurring radioactive minerals in the rocks, soils, sediments, etc (UNSCEAR, 1988).

^{210}Po belong to naturally occurring ^{238}U series having considerable half live 138.4 days respectively and are present in almost all environment matrix. The main source of ^{210}Po entering the environment is the exhalation of ^{222}Rn , a daughter product of ^{226}Ra which continuously escape from the surface the earth.

^{222}Ra decay to ^{210}Pb and ^{210}Po which attach themselves to atmospheric particulates and are transported back to earth's surface (Holtzman, 1996; Abe and Abe, 1980). Other source of ^{210}Pb and ^{210}Po are radioactive releases during coal burning process, phosphate mining etc, which contain significant quantities of natural uranium and its daughter products (Bangera and Rudran, 1995). The nuclide dispersed in the hydrosphere is diluted, transported and concentrated by physical, chemical and biological process. The natural alpha emitters, ^{210}Po is of radiological interest for a number of reasons but mainly because of its large contribution (79%) to the natural radiation dose received by many species (Cherry and Shannon, 1974; Cherry et al., 1983). Its toxic to living system and is accumulated strong by organism and transferred via food along a trophic chain (Parfenov, 1974 ; Heyraud and Cherry, 1979, Skwarzec, 1988). Among the various geological formations, sediment plays a predominant role in aquatic radioecology and plays a role in accumulating and transporting contaminants within the geographic area. It is the basic indicator of radiological contamination in the environment. In the present research work deal with natural radionuclide of Polonium-210 activity in different aquatic ecosystem, Tamil Nadu, India.

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2. MATERIALS AND METHODS

Study area

Koraiyar is one of the seasonal rivers in Tiruchirappalli and it merges with Kaveri river. More amount of water is present during rainy season. The river water is used for irrigation, industrial and other domestic use. The sampling station Deeran Nagar is 5Km away from Tiruchirappalli Bus Standard. Athankarai estuary is situated in Palk Strait 16Km east of Ramanathapuram in the east coast of India and river Vagai confluences with Palk bay. The fishes were collected using cast net and packed in polythene bags and stored in refrigerator soon after collection. The muscle and bone were separated in fishes and the wet weight of the samples were recorded and then dried in an oven at 110°C overnight to obtain the dry weights.

Radiochemical determination of ^{210}Po

The fish muscle samples (~25 -50g) were wet processed repeatedly with concentrated HNO_3 and H_2O_2 (1:1) oxidising mixture added in small increment (5-10 ml at a time) till a white residue was formed. After several additions of concentrated HCl and digestion, the solution was made up of 0.5 N HCl and ^{210}Po was plated on a silver planchette by electrochemical displacement method (vide infra) and the activity was alpha counted (Holtzman,1969).

Electrochemical deposition of ^{210}Po

The above mentioned sample solution in 0.5 N HCl was placed on a magnetic stirrer with thermostat control at a temperature of 90-95° C. Ascorbic acid (100 mg) added to reduce ferric ions to ferrous, thus eliminating interference in electrochemical deposition of ^{210}Po . A silver planchette (0.8 mm thickness and 2.5 cm diameter) of pre-determined background whose both sides were brightly polished with emery paper was suspended in the sample solution by means of a nylon thread at the end of a glass rod, connected to a stirrer. The solution is stirred for a period of 5-6 hours. Spontaneous deposition of ^{210}Po on both sides of the silver planchette took place under these conditions. At the end of the plating period, the planchette was taken out, rinsed with alcohol, dried under an infrared lamp for few minutes and

counted for activity in both sides in an alpha counter.

2. RESULTS AND DISCUSSION

The activity concentration of ^{210}Po measured in the muscle of fishes were collected from different aquatic system Koraiyar river (Trichy) and Athankarai estuary (Palk strait) are given in Table 1. The ^{210}Po concentrations in the muscle ranged from 10.52 to 45.3 Bq Kg^{-1} and in bone from 8.7 to 25.09 Bq Kg^{-1} . these value were higher than the value reported for Kaveri river muscles (1.86 to 4.17 Bq Kg^{-1}) and bone 1.34 to 3.63 Bq Kg^{-1}) (Shaheed, 1997), and Kudamurutti river fish (Muscle 2.4 to 11.7 Bq Kg^{-1} and bone 3.6 to 15.8 Bq Kg^{-1} , Masillamani,1996). The major route of radionuclides entry in organisms is through food or through ambient water (Iyengar, 1990). Further the gill membranes may play predominant role in the direct absorption of radionuclides from water.

The concentration of ^{210}Po in fish muscle was recorded in the range of 20.8 to 181.3Bq Kg^{-1} for Athangara estuary and in bone from 12.6to102.2Bq Kg^{-1} , these value were higher than those reported for the fish muscles and bone of Mandapamcoastal ecosystem (18.6-148Bq Kg^{-1} and 5.6-58.9Bq Kg^{-1}) respectively (Somasundaram, 1998). In general it was observed that the plankton feeder fish, *Sardinella longiceps* of recorded higher ^{210}Po activity than Athangarai. Plankton being minute in size has a greater surface area and hence exhibits the higher bioaccumulation of ^{210}Po . Fishes are radionuclides to human. Lower concentration ^{210}Po in muscles is important in human who consumes mostly the muscle of fish. This accounts for low rate of dose transfer to man (Iyengar, 1983). The Pulicat lake fishes ^{210}Po concentrations varied between 38.3 and 109.3 Bq Kg^{-1} . The highest value (109.3 Bq Kg^{-1}) was observed in *Johnius dussumieri*, followed by *Oreochromis mossambicus* (105.1 Bq Kg^{-1}) and *Leiognathus splendens* (102.6 Bq Kg^{-1}). The ^{210}Po concentrations are low in other species. In addition, the difference in these levels of radioactivity in different species of fish could be due to differences in metabolism and feeding patterns. The higher concentration of ^{210}Po observed in these fishes could possibly due to their benthic mode of life and detritivore feeding, which tend to accumulate more ^{210}Po . The ^{210}Pb concentration in the muscle of fish ranged from

0.72 - 2.7 Bq.Kg⁻¹(Musthafa and Krishnamoorthy, 2011). The ²¹⁰Po and ²¹⁰Pb concentrations in the edible tissues of fish are higher in the present study than reported for fishes in Palk Strait Coastal environment, India (Al-Masri *et al.*, 2000) and Marshall Island, America (Bangera and Rudran, 1995). The values of ²¹⁰Po concentrations were lower in the present study than those reported for fishes in marine environments of Japan and Syria (Yamamoto *et al.*, 1994)

ACKNOWLEDGMENTS

Authors were thankful to Dr. A.K. KhajaNazeemudeen Sahib, Secretary and Correspondent, Dr. S. Ismail Mohideen, Principal and Dr. Mohamed Shamsudin, Head, P.G. and Research Department of Zoology, Jamal Mohamed College (Autonomous), Tiruchirappalli for Institutional support. We profoundly thank Department of Atomic Energy, Government of India, Mumbai for instruments support of the project.

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Table 1. Concentration of ²¹⁰Po in the fishes of Koraiyar River and Athangarai Estuary.

S.NO	KORAIYAR RIVER	Po 210 activity(Bq Kg ⁻¹)	
1	<i>Anabas testudineus</i>	Muscle	11.071.03
		Bone	4.76±1.18
2	<i>Catlacatla</i>	Muscle	18.9±1.02
		Bone	6.66±1.92
3	<i>Clariasbatrachus</i>	Muscle	45.3±1.53
		Bone	25.1±7.34
4	<i>Channapunctatus</i>	Muscle	11.2±1.03
		Bone	5.4±3.5
5	<i>Oreochromis mossambicus</i>	Muscle	10.52±4.32
		Bone	8.7±1.02
ATHANGARAI ESTUARY			
6	<i>Sardinellalongiceps</i>	Muscle	181.9±4.2
		Bone	102.2±2.4
7	<i>Thryssamalabarica</i>	Muscle	88.9±4.4
		Bone	51.7±2.6
8	<i>Sphyraena barracuda</i>	Muscle	83.9±4.3
		Bone	37.0±2.9
9	<i>Tachysurusjella</i>	Muscle	20.8±1.1
		Bone	12.6±0.8
10	<i>Scolopsisvosmeri</i>	Muscle	30.7±2.5
		Bone	22.9±2.4