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STUDIES ON THE BIOACCUMULATION OF PO -210 IN THE VEGETABLES OF TIRUCHIRAPPALLI CITY

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ABSTRACT

Natural radiation constitute about 97.7% of total radiation dose received by organisms and the remaining comes from nuclear power sector, nuclear tests, medical and miscellaneous. Major contribution to the various radiation exposure received by mankind comes from natural sources. In the present study distribution and bioaccumulation of Po-210 has been undertaken in Vegetables from Tiruchirappalli City. Samples of carrot, radish, beans, brinjal, tomato, potato, beet root, cabbage, ladies finger and greens are collected and analyzed. Among the vegetables analyzed, the root growing vegetables recorded a higher level of Po-210 than the shoot growing vegetables. The highest Po-210 content were found in the Carrot (1.10 Bq/kg) and Beet root (0.71 Bq/kg). In the present study low levels of Po-210 was recorded in Tomato (0.17 Bq/kg). The results are discussed.

INTRODUCTION

Po-210 and Pb-210 occur widely in the environment and constitute important components of the natural background radiation. Their presence in the terrestrial environment arises from Rn-222 which is a noble gas and produced by alpha decay of Ra-226. The half-life of Rn-222 (3.82 days) allows sufficient time to diffuse from soil to the atmosphere where it decays to Po-210 and Pb-210. These radionuclides are no longer in a gaseous form, therefore, return back to the earth's surface by both dry and wet deposition and its existence in all foodstuffs is unavoidable (Ioannides *et al*., 1997; García-Orellana and García-León, 2001; Karunakara *et al*., 1967). Pb-210 and Po-210, decay products of the uranium series, dissolve in water and are first transported into plants and subsequently transported from plants to human (Alam *et al*., 1997). Po- 210 easily enters the human body. Consumption of food is usually the most important route by which this radionuclide enters the human organs. The Po-210 is distributed in soft tissues after intake.

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Polonium 210 decays with a half life of 138.4 days by alpha emission (5.3 meV). Po-210 causes considerably greater biological damage compared to beta emitter Pb-210. Vegetables may be subjected to direct and indirect contamination of uranium series radionuclide, mainly by Po-210 and Pb-210. The direct contamination of vegetables occurs by the deposition of radioactive particles from the atmosphere onto the above-ground parts. Primary direct deposition involves three processes: deposition, interception and retention.

Indirect contamination refers to the absorption of radionuclide from the soil by the root system. In addition, activity already deposited on the ground may be re-deposited on vegetables by the wind, and then transferred to vegetables (Pietrzak-Flis and Skowronska-Smolak, 1995; Santos *et al*., 1993). Consumption of food is usually the most important route by which natural radionuclide's can enter the human body and assessment of natural radionuclide levels in different foods and diets is therefore important to estimate the intake of this radionuclide by man. The present study was carried out to analyze the activity concentration of Po-210 in some common vegetables from Tiruchirappalli city market.

MATERIALS AND METHODS

Analysis of Biological Materials

Owing to the highly volatile nature of Po-210 in dry ashing conditions, the biological samples (-25 – 50 g) were wet processed repeatedly with concentrated HNO_3 and H_2O_2 (1:1) oxidizing mixture added in small increments (5-10 ml at a time) till a white residue was formed. After several additions of concentrated HC1 and digestion, the solution was made up to 0.5 N HCL and Po-210 was plated on a silver planchette by electrochemical displacement method and the activity was alpha counted (Holztman, 1969; Iyengar, 1983).

Electrochemical deposition of Po-210

The above mentioned sample solution in 0.5N HCl was placed on a magnetic stirrer with thermostat control at a temperature of 90-95º C. Ascorbic acid (100 mg) was added to reduce ferric ions to ferrous, thus eliminating interference in electrochemical deposition of Po-210. A silver planchette (0.8 mm thickness and 2.5 cm diameter) of predetermined 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 Po-210 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 on both sides in an alpha counter.

RESULTS AND DISCUSSION

Analytical results for the Po-210 activity in vegetables collected from Tiruchirappalli city market are presented in Table 1. From the table, it can be observed that Po-210 activity levels in all measured vegetable samples ranged from 0.17± 0.05 Bq/kg to 1.10 ± 0.23 Bq/kg. Among the different varieties of vegetables Po-210 was significantly higher in rooted vegetables as compared to leafy vegetables and other type of vegetables. In the present study, the Po-210 concentration in rooted vegetables ranged from 0.39 ± 0.05 Bq/kg to 1.10 ± 0.23 Bq/kg, shoot vegetables was ranged from 0.17 ± 0.05 Bq/kg to 0.32 ± 0.06 Bq/kg and other greens was 0.25 ± 0.09 Bq/kg. However the present values were higher when compared to the pervious study results.

Table 1. Po-210 activity in vegetables of Tiruchirappalli City

S. No	Sample	Po-210 activity (Bq/Kg)
1	Beetroot	0.71 ±0.12
2	Carrot	1.10 ±0.23
3	Raddish	0.39 ±0.05
4	Beans	0.32 ±0.06
5	Potato	0.43 ±0.05
6	Brinjal	0.28 ±0.03
7	Ladies Finger	0.21 ±0.05
8	Cabbage	0.25 ±0.02
9	Tomato	0.17 ±0.05
10	Araikerai	0.25 ±0.09

The activity concentration observed in carrot 1.10 Bq/kg lower than reported by Santos *et al*., (1990) which was 3.52 Bq/kg. Pietrzak –Flis *et al*., (1997) reported that Po-210 concentration in vegetables of potato 33 Bq/kg, cabbage 39.9 Bq/kg, tomato 27.9 Bq/kg and beet root 49.1 Bq/kg, this results are very high when compared to present study. Mc Donald *et al*., (1999) reported that Po-210 activity ranged in leafy vegetables ranged from 0.004 to 0.140 Bq/kg and root vegetables ranged from 0.001 to 0.0013 Bq/kg. Giri *et al*., (2010) revealed that Po-210 activity in Ladies finger 0.27 Bq/kg, Tomato 0.76 Bq/kg, and Brinjal was 1.61 Bq/kg these results are higher when compared to present study. Santos (1990) reported that Po-210 activity in beet root 3.0 Bq/kg, cabbage 4.0 Bq/kg, carrot 3.0 Bq/kg and radish 2.60 Bq/kg these results shows higher level compared to present study. Zoafia Pietzak – Flis *et al*., (1995) reported that Po-210 activity ranged in vegetables 0.79 Bq/kg to 1.32 Bq/kg these results are similar to the present study.

Conclusion

The present study was carried out for the analysis of Po-210 activity in the vegetables samples of Tiruchirappalli city. The maximum Po-210 activity was found to be carrot 1.10 Bq/kg, beet root 0.71 Bq/kg, and minimum Po-210 found in Tomato 0.17 Bq/kg. Among vegetable analyzed rooted vegetables had higher Po-210 concentration compared to shoot vegetables. The present study suggested that Po-210 level are founded to be lower in vegetables of Trichirappalli city market compared to naturally High Background Radiation Areas (HBRA).

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