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The Effect of Marine Algae on Radioactivity Adsorption of Iodine in Drinking Water

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Abstract: The aim of study is to determine radio isotope absorption concentration by algae in drinking water. The drinking water with algae was prepared in the stream of Mahan City of Kerman Province, Iran. The case sub samples of drinking water were polluted by 0.5 mL of ^{125}I among other radio nuclide 125, because of the low ^{125}I activities in drinking water. Gamma counting was used as the determination method. Radio iodine in algae were radiated with gamma radiation and counted using gamma counting techniques. The source for the gamma emission measurement was prepared from a radioactivity aqueous solution. The activity concentration was calculated via gamma counting machine. Using evolution of ^{125}I in the algae, absorption quantity of radionuclide was determined by 24%. The ^{125}I activity concentrations were determined by the present study varied significantly, ranging from 135 to 210 CPM (count per minute. The high concentrations indicate an obvious lapse of environmental safety precautions. If the concentrations of Iodine-125 were so immensely high in these organisms, one shudders to think of those organisms where the radioactivity concentration of drinking water could not be so easily traced. Its conclusion can be realized that radio Iodine-125 would be absorbed by all parts of algae in the drinking water.

Key words: Radiation, protection, algae, management, absorption

INTRODUCTION

A stream of drinking water runs down all the time in the zone of Mahan City of Kerman Province, Iran. The preliminary survey of the source of drinking water in the stream and its surrounding area held in 2009 indicated increased levels of algae in it. No radio iodine was detected in the drinking water. According to the Independent, Scientists at the Indian Atomic Energy Regulatory Board (AERB), the agency in charge of safety aspects of nuclear energy in India, said marine algae had been selected for the survey because they are regarded as indicator organisms which have a tendency to accumulate iodine (Doshi and Doshi, 1989). Nuclear task force of Great Britain in a report on bio accumulation.

Elements to accompany the inventory of radionuclide in the great lake basin that the uptake of radium did not differ between live and dead algae, suggesting at least for some radionuclide, the importance of passive adsorption mechanisms in the bio uptake processes. Lenntech was created in 1993 by Alumni from the Technical University of Delft, the Netherlands said that Brown algae accumulate up to 0.45% (dry mass) of iodine.

Although, the amounts constitute of a trivial radiation dose to man and they are far below the acceptable limit of exposure for man, but accumulation of radio-iodine in the

thyroid causes greater harm in young children. A great deal of reported cancer sites give rise to controversy in terms of the cause-effect association with ionizing radiation exposure and also due to incomplete data on exposure level (Wilczyñska and Szeszenia-Dabrowska, 2008).

A radiation protection programme should be implemented on the drinking water. This is because the thyroids are smaller, thus the dose per gram of the organ is consequently greater. In addition, because the cells in children are dividing more rapidly, damage is potentially greater as damage to cellular material caused by radiation are more likely to be inherited by daughter cells (Hung *et al*., 2006; Bobrow, 1993). Relatively high count rates are frequently obtained, the levels of radio-iodine in thyroids are too low to affect the health and well-being (Bobrow, 1993). For all these reasons, it is imperative that a health survey especially of children be conducted at once so that remedial action can be taken without delay (Smyth *et al*., 2008).

The increased algae is due to the waste disposal or large quantities of usage in human nutrient and various chemical materials products in the area They are consisted of saturation fatty acid production, the amino acid, protein, poly saccarid, mono saccarid, mineral material and vitamin (Wilson *et al*., 2007). Wilczyñska and Szeszenia-Dabrowska (2008) said distant effects of exposure to ionizing radiation appeared to be a particular problem. These were cancers certified up to the year 2003 in persons with documented employment. The radio iodine in the drinking water of people might be adsorbed by algae. Variations of magnitude of Iodine-125 in the environment cannot be attributed to increased iodine uptake, but the releases from the radioactivity sources. The purpose of this study is to determine radio isotope absorption concentration by algae in drinking water.

MATERIALS AND METHODS

The research of role of algae in radio iodine adsorption has been undertaken from 1 January 2009 to 1 January 2010. Two samples of drinking water from stream with algae were prepared and collected in polyethylene bottles. Four 500 mL containers of drinking water with algae samples were collected. Three sub-samples dishes were as a case and one sub-sample dishes as a control. Samples of drinking water from the two sources, involved in putting aside procedure under light and nutrient added to complete growth during 3 days before analysis. Algae were put in dishes so that the end of containers was covered by them. A radioactive tracer as 0.5 mL of ^{125}I with distilled water (694 CPM (count per minute)) was added each case sub-sample, but nothing into the control. The sub-samples were to be analyzed. When they had less water, so distilled water was added to the solution. At the end of third day, wet algae have been transferred to special vials for analyzes.

Absorbed radio Iodine-125 in algae were detected by gamma counting machine in the laboratory. This is described by standard method book for environmental samples, radio Iodine-125 in the algae was measured by gamma counting machine and model name was automatic gamma counting system with serial No. GM1 8335 S 307 and manufacturer name KONTRON which its location of making was also in Switzerland. The minimum detectable activities, based on an average detector efficiency of 23% and a counting period of 20 sec, were 75 CPM for ^{125}I. The equipment used was a fully automated of 12 passivity implanted planar silicon detectors with a 600 mm^2 active area.

To transfer the data from the machine to an external database, computer software was developed. This software automatically reads the report files from the machine and transforms the data to an appropriate format; the data are stored in the above mentioned database.

The determination of iodine isotope must take into account the rapid growth of its decay chain. In the case of the ^{125}I determination, a solution of distilled water was used to determine the biological recovery of algae. In the solution, old ^{125}I was in secular equilibrium with new radionuclide, the activity of old ^{125}I at the dilution time was equal to the activity of new ^{125}I.

During the ion exchange, ^{125}I remained in the sample solution, whereas its product was removed. For the chemical recovery calculation of ^{125}I, the added distilled water has to be determined. As ^{125}I is a beta emitter, its activity can be calculated by means of gamma counting machine.

RESULTS AND DISCUSSION

Water in the dishes of case and control sub samples was observed regularly. The water level in dish 1 was unchangeable, but water level in dishes 2, 3, 4 was decreased. The dishes 2, 3, 4, except 1, have been added distilled water sufficiently. All dishes have been placed to access the light for chlorophyll as compliment of nutrient. In the third day, the dishes 2, 3, 4 had less water and the algae seemed to be darkness instead of green color. Chloroplast of algae was deformed and chlorophyll A and B were destroyed. The addition of distilled water permitted the calculation of final chemical yield, which resulted average of 183 CPM for radio Iodine-125 in the algae. The ^{125}I activity concentrations were determined by the present study varied significantly, ranging from 135 to 210 CPM (count per minute). Radio Iodine-125 concentration+drinking water+algae were detected in all case sub samples in average 183 and 694 CPM, respectively. The Ratio of radio iodine+ drinking water+algae to radio iodine+ drinking water is 26%. This shows algae in drinking water can uptake the radio iodine (Table 1).

As it is well known, ^{125}I is a radionuclide that can be found in the environment, water, food and air at low concentrations. Estimates in total daily intake vary with geographical location. Obluchinskaia (2008) said the Barents Sea algae may become an important source of biologically active compounds. Comparing with the data for ^{125}I given by control sub-sample as ratio to Radio iodine+ drinking water to case sub-sample as radio iodine+ drinking water+algae, show that the activity concentrations as found in the sub-sample case study as ratio radio iodine+drinking water+algae are higher (Table 1).

The experimental procedure described in this study, including providing the samples, pre-concentration and gamma counting of radio iodine in algae, can be completed in 3 day for a batch of two samples. The algae sub samples were measured on average 4 day after deposition in order to reduce the ^{125}I activities in algae and maximize ^{125}I due to the growth in algae. Organism growth increases capacity of bio accumulation for a given nuclide. Organism reproduction also provides a mechanism to create more capacity to accumulate more material. The gamma activity was good quality for all sub-samples.

Table 1: Role of algae in radio iodine concentration adsorption

Sample	Sub sample	Time (sec)	A (activity)	CPM (count min^{-1})	Average (CPM)	Ratio radio iodine+ drinking water +algae to radio Iodine+ drinking water
Case 1	Radio iodine+Drinking water	20	110	550	694	26%
Case 2	Radio iodine+Drinking water	20	142±5	710±25		
Case 3	Radio iodine+Drinking water	20	164.5±5.5	822.5±27.5		
Control	Drinking water+algae	20	15±0	75	183	
Case 1	Radio iodine+Drinking water+algae	20	27±1	135±5		
Case 2	Radio iodine+Drinking water+algae	20	41±1	205±5		
Case 3	Radio iodine+Drinking water+algae	20	42±2	210±3		

Comparing the results of sub sample control in this study with the radio iodine in algae determination from case sub sample, it can be noted that it is almost the more radio iodine in case sub sample algae in drinking water samples because of the algae takes radio Iodine-125. Recent results on the physiological role and biochemistry of the vanadium haloperoxidases of brown algae emphasize the importance of these enzymes in the control of these processes (Warsh, 1988; Leblanc *et al*., 2006). The Barents Sea algae may become an important source of biologically active compounds. For these sub samples, the procedures were repeated. Despite these minor disadvantages, the described method, from the point of view of algae absorption, provides good results. Wilson *et al*. (2005) results suggest that in general, iodine turnover in periwinkles is slower than observed for other molluscs (monophasic biological half-lives in the order of 2-3 days. Both environmental media, food and seawater, can be significant sources of radioiodine for the winkle. The study clearly indicated the need for increased monitoring and surveillance of the discharges from the radioactivity source. Valentin (2005) reported the response to radiological events should be before and following the customary processes for optimisation of radiological protection and that optimised measures should be prepared in advance.

CONCLUSION

It can be realized that radio Iodine-125 would be absorbed by all parts of algae in the drinking water.

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