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Assessment of Radioactivity in Plants Socialite Water

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Abstract: Water, soil and plants sources are concentrators of radioactivity and constitute a good indicator for radioactive contamination in the arid environment. There were few data for radioactivity in arid, semi-natural ecosystem. Radioactivity of soil, water and plant in the eastern arid border of Iran was unknown. This has been measured in sources of plant, soil and water as samples for assessment of radioactivity. The results showed that the mean radioactivity in plant is 772±95 Bq per kg dry plant, in soil is 268±50 Bq per kg dry soil and in water is 216±31 Bq per liter waste. Therefore, radioactivity concentration of ionizing radiation in plants is more than water and soil sources in eastern arid border of Iran, Sistan and Blouchestan province.

Key words: Radioactivity, radioisotope, soil, water sources, plant growth, arid border

INTRODUCTION

Radioactivity of radio nuclides can contribute to the pollution courses. It occurs in particular:

- Atmospheric nuclear tests
- Research laboratories and analysis
- Services of nuclear medicine

The radioactivity of water, soil and plant in various regions of world are measured. Absorption of radionuclide from soil to plant has been related to some factors in the soil and plant. Dowdall *et al.* (2005) measured radioactivity in vegetation of Norwegian place and showed levels of radionuclide in vegetation generally followed the order mosses > lichen > vascular plants. Coughtrey and Throne (1985) and Zhu and Smolders (2003) showed soil to plant transfer varies with the bio incorporation of elements and soil-to-plant transfer concept generally used in dose assessment modeling. The plant uptake of a radionuclide should depend linearly on its concentration in the soil (Schimmack *et al.*, 2003). Ciuffo *et al.* (2003) also revealed a gradual decrease in the radionuclide TF(sp) when the (40)K soil activity concentration was increased. McClellan *et al.* (2003) results indicate that the radionuclide such as thorium progeny were the predominant contaminant in soil and vegetation. Although some of radio nuclide is less in its half-life and energy but some kind of plants might store it (Vandcasteele *et al.*, 1983). The storage of radio nuclide by some plant has been researched (Absalom *et al.*, 2001). Andersson *et al.* (2001) concluded that natural areas are vulnerable to contamination, resulting in high concentrations in plants for a long time. The type of soil can affect absorption of radionuclide from soil to plant. Comparison with in-vitro data obtained for an upland soil indicated that absorption from some upland organic soils could be greater than from the lowland organic soil (Cooke *et al.*, 1996).

Most diseases incidence in arid eastern border of Iran might be related to radioactivity. It is a plausible working hypothesis that the radioactivity of radioisotopes might play a role on occurring disease. On the other hand, the relationship of radioactivity and diseases in arid eastern border of Iran has not been known, because the concentration of radio nuclides in arid eastern border of Iran was unknown. Therefore, it is necessary to understand the activity of different media in arid eastern border. Present research presents the amount of existing activity of different water, soil and plant in the regions, especially plants spontaneously growing on non-cultivated and non-fertilised field contaminated with radio nuclide. This study has been undergone in five sites in different eastern arid border points of Iran to measure the concentration of radio nuclides in soil, water and vegetation samples.

The results might be of interest because there were few data for radio nuclides from arid, semi natural ecosystem.

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MATERIALS AND METHODS

The village's population of border was required to generate a suitable sample size in eastern border. Road was either zero or 50 km distance to the border. If there was any road on the border, samplings were collected 50 m away from the road. All areas were marked with wooden pegs to aid the relocation. The monitoring was terminated by the complete use of the sample area. All the samples were taken from arid eastern border of Iran in Sistan and Blouchestan province in 2004-2005 years.

Limitations on the sampling were (a) it was known that spatial variability could be important if too large an area was sampled, (b) each sample would be destructive © counting facilities and sample numbers were limited. For these reasons it was decided that the sampling would be limited to an area and that sampling would be restricted to single area at each visit.

All the samples were taken for two times from two places. The samples were collected before any rain falling during summer and autumn. There were 25 samples of grass, 28 samples of soil and 34 samples of water in which radioactivity are determined by multi channel gamma counting set. Some of radionuclide is a very low gamma and X-ray emitter radionuclide. Many natural radio nuclides and their daughter products such as Uranium-238 and Th-232 chains or other single occurring natural radio nuclides such as K-40 also cosmogenic radio nuclides and man-made radio nuclides can cause the same counts and activity on the above mentioned gamma counters. All the measurements based on the common gamma counter are valid in environmental samples. The experiments were experimental results.

The grass samples were taken from the dried eastern borders. Vegetation results were represented as concentrations. A grass sample consisted of the leaves and thin stem of grass. During the study the material measured would also consist of both surface deposit plus any material taken up by roots. Subsequent samples would represent mainly material taken up by the plants, during the winter period the majority of the previous year's growth would become incorporated in to the litter layer by decay.

The mass of 2 kg grass was collected at each sites, then washed by distilled water, air- dried, ground to pass a 0.7 mm mesh sieve and sub sampled into the especial glasses as 10 g dry weight of plant.

Soil samples were taken at each site in different dates before raining in the morning by removing a 20×20 cm soil block as deep as zero to 30 cm. This block was then rendered into mixture. After drying at room temperature, the soil was passed through a 2 mm sieve to remove stones and all subsequent analysis was performed on the less than 2 mm fraction. The 25 g mass of soil was analyzed for gamma emitters.

Four liter of wells, surface water and ponds as water samples were collected where that source were available. Then, 15 mL of water as sub sample was poured into laboratory container.

It is notable that the water source of site 4, Chahbahar, was created by rain in ponds when it was rainy in winter and used as drinking and washing water. Water samples were collected from wells. The hydrogeology of the area showed height of groundwater. It was 10-20 from the ground.

The gamma counter detectors analyzed each samples. At first, the standard radionuclide compound was put under the detector to be calibrated and the detector machine itself was calibrated for same radionuclide; so this set was calibrated by standard radionuclide and itself before using it. Then, gamma emitting radio nuclide in the samples was quantified by the detector machine.

Counting errors vary with sample activity but, at 95% confidence level, they were at 5-8% radio nuclide.

Concentration of radio nuclides in plants differ in five sites, when the sites were compared to each other. Mirjaveh border and Zaboul border slopes were low.

Different points of five sites were used in this study at eastern border of Iran.

The characteristics of all five sites are as followed: The first site, Zaboul border, was 50 km by the only border road. The vegetation was grassland dominated by Alfalfa and oat. At the sampling site the soil was highly sand, to a depth of 17.5 cm where suitable soil for planting was encountered.

The slope of second site, Mirjaveh border, was lower than first one. The vegetation was grassland with a richer species component than at first. The soil is a sandy.

The third site was Saravan border. Vegetation is a grassy sward dominated by species of a somewhat less acidic habitat than the other sites. The soil has a thin surface layer colored by loamy material, below which is a suitable soil.

The fourth site was Chahbahar near Omman Water at an altitude of zero meters. There was sporadic vegetation where trees were more. The soil is completely sandy with a surface layer colored by material.

The fifth site was Pishin border that it has water and grass. The soil was suitable for farming. The water was gathered behind the dam. The soil was loamy. All five sites were on common land open to grazing by local flocks of sheep, the intensity of grazing would vary with season but was lightly differed with enclosed pastures. Estimates from field observation indicated that although animals graze with uneven distribution pattern at any one time, the average grazing density was unlikely to exceed one animal per hector. Vegetation in site 3, in Saravan border when compared to sites 1, Zaboul border and site 2, Mirjaveh border was more; the vegetation concentration was more than two other samples.

RESULTS AND DISCUSSION

The concentration of radio nuclides in plants was determined as 1396±420 Bq kg^{-1} dry plant in Saravan border which is relatively increased when compared to the other border sites (Table 1).

Radioactivity in vegetation in site 3, Saravan border 1396±420 Bq kg^{-1} dry plant was high and decline by almost in an order of magnitude at all other samples. It showed that the pollution in plants of the site 3, Saravan border was more than the other sites. According to Table 1, the pollution of plants in Pishin and Chahbahar regions were increasing. However, the pollution in plants at Saravan region was high. Radioactivity pollution of plants in Mirjaveh region 992±354 Bq kg^{-1} dry plant and Zaboul region 396±31 Bq kg^{-1} dry plant were decreased in comparison with Saravan border.

The concentration of radionuclide in soil, 449 Bq kg^{-1} dry soil weight, was increased in site Chahbahar region relative to other sites. In Chahbahar region, the pollution of radioactivity in soil was high, but this pollution was decreased in Saravan, 266 Bq kg^{-1} dry soil weight, Mirjaveh, 415 Bq kg^{-1} dry soil weight; and Zaboul region, 186 Bq kg^{-1} dry soil weight (Table 2).

Radionuclides concentration in water was increased in site Pishin region 335 Bq L^{-1} relative to other sites. In Pishin border high pollution of radioactivity was in water, they were decreased in sites Chahbahar, 280 Bq L^{-1}; Saravan, 218 Bq L^{-1}; Mirjaveh, 207 Bq L^{-1}; and Zaboul areas, 280 Bq L^{-1} (Table 3).

The situation on the five study areas is complicated. There are statistically significant decrease in radioactivity in the water and soil when compare to plant. There is a decrease in radioactivity in which is partly due to some elements (Zhu (Table 4) and Smolders 2003).

Comparative concentrations of radioactivity shown in the Table 1-3 results in radioactivity in plants are more in some sources. Therefore, the highest concentration is found in plants. The experiments show radio nuclide concentration of plants, especially the standing crop of an area is affected by a number of factors.

The soil to plant transfer varies with the bio incorporation of the element. Results show that an important part of the recycled bio incorporated is immediately and highly available to plants. If the concentration in the vegetation section is in Bq per kg plant weight, typical values are around 500 Bq per kg dry plant weight. The soil concentrations are typically around 300 Bq per kg soil weight. This suggests a plant: soil concentration ratio of about 1.7. On a fresh weight plant basis, the corresponding ratio will be around 0.2. This is toward the top end of the range reported by Coughtry *et al.* (1985). However, it suggests bio accumulation in these systems relative to the temperate

Table 1: The radioactivity of plant sample in different site

		Quantity of radioactivity (Bq kg^{-1} dry plant)	
Location of plants	Site No.	Maximum	Minimum
Zaboul border	1	396±31	365
Mirjaveh border)	2	992±354	638
Saravan border	3	1396±420	969
Chahbahar border)	4	600±50	550
Pishin border	5	471±109B	362

Table 2: The radioactivity of soil sample in different site

		Quantity of radioactivity (Bq kg^{-1} dry soil weight)	
Soil location	Site No.	Maximum	Minimum
Zaboul border	1	186	168
Mirjaveh boarder	2	415	143
Saravan boarder	3	266	224
Chahbahar boarder	4	449	367
Pishin boarder	5	275	187

Table 3: The radioactivity of water sample in different site

		Quantity of radioactivity (Bq L^{-1})	
Water location	Site No.	Maximum	Minimum
Zaboul border	1	207	100
Mirjaveh border	2	237	110
Saravan border	3	218	128
Chahbahar border	4	280	270
Pishin border	5	335	255

Table 4: The average radioactivity of each sample in different site

Sample location	Site No.	Plants (Bq Kg^{-1} dry plant) Average radioactivity	Soil (Bq Kg^{-1} dry soil) average radioactivity	Water (Bq L^{-1} water) sample average radioactivity
Zaboul	1	396±41	177±9	180±27
Mirjaveh	2	992±354	279±136	213±21
Saravan	3	1396±420	245±21	173±45
Chabahar	4	600±50	408±41	220±24
Pishin	5	476±109	231±44	295±40

environments that are more usually studied. The short half-life of some radio nuclides means that it is the initial phase of either plant or soil uptake that must be dominating, rather than any long-term biogeochemical cycling process. Both foliar and soil uptake could make substantial contributions and mobility in and uptake from soils are strongly affected by the vertical profile of moisture content and redox conditions.

In practice, contamination is highly dependent on factors such as the growth or the plant species, the condition of the plant at harvest and the weather during the growing season (Coughtry *et al*., 1953). It was very difficult to predict the effect of weather and the contamination by rain splash before harvest. Few measurements are carried out on samples in this area. In some of the cases, the activities are lower than the thresholds of detection (< 0.1 to 3.7 Bq L^{-1}). Radionuclide concentration in site 1 is less than other sites, because there are lack of plant or less plant than other sites. Therefore, radioactive in this area is less. Plant species in other site is more than site 1, so the radioactive contamination in comparative to available plant is more. Geographical conditions of those areas are different from each other. The radioactive concentration in these points in relative to its geographical situations is variable. The researcher can study over factors which affect on plant. The results of study may differ from others in which they attained, because the other factor may change in this soil. In these regions, there are more weather and less rainfall that affect on uptake of plants. Although there are water sources as river or sea, but these situation is not in every region. Fortunately, radioactivity in the media is less to be hazard in more regions.

However, the uptake of radionuclides from soil into vegetation or from water could enter into food chains and subsequently be integrated by man, thereby causing a radiological hazard. The data of radioactivity is not available that shows the activity is not measured by the health station of the Iran. As it is mentioned, the activity of the area depends on the deposition of geographical situation and of its characteristics. According to a new study, countries that have a higher rate of radioactivity use have higher diseases such as cancer rates attributable to radiation. There are not any values to show the rate of diseases and radioactivity in this region. We hope to measure the disease in the area and relate these diseases to available radioactivity. The radioactivity in this area is not being increased and it might not cause disease. However, a commentary accompanying the study noted that by helping to detect disease and radio isotopes early, it will probably enable the cure of more disease related to radioactivity than they cause.

Hence, efforts are currently being undertaken to create a radiation database, in the form of a radiation level map of radioactivity, to be used to assess the associated radiation risk to public and workers

CONCLUSIONS

The vegetation radioactivity in comparative to water and soil in eastern lines of Iran border shows high enough and must be stopped or diminished.

Suggestions

- Preventive management of the risk/the management of the crisis,
- Identification and the reduction of the sources and the consequences,
- Diffuse risk management/accidental risk management.

It rests on elaboration and the setting in of regulations and on the realization control, as well by the organizations of supervision as by the owners/the users.

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