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## Assessment of Potassium Isotope – 40 in Ardabil Soils

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## ABSTRACT

Soil health is one of the most important issues in the production of agricultural products. The theory of Volcanic Sabalan Mountains in Ardebil and Chernvil nuclear power plant incident in natural activity has led to this study to determine the isotope potassium-40. The purpose of this study was assessment of potassium isotope 40 amounts in Ardabil soils. Due to the accumulation of potassium 40 in the gland products, soil sampling taken from potato farms and gardens produces vegetables and summer crops in Ardabil, From the 30 cm of the soil. Data comparison with American Idaho nuclear power plant through t-test performed in SPSS software. Results of this study showed that radio nucleotides in soil (potassium isotope 40) has Average 794, median 812, mode 634, SD 128, variance 16395, minimum 634 and maximum 984. The measurement results of potassium isotope-40 showed that in the all-sampling points, potassium isotope-40 content is higher than the standard of Iran's Atomic Energy.

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## INTRODUCTION

One of the potentially harmful environmental factors is Ionizing radiations that caused by natural resources with cosmic origin and natural radioactive materials in the earth's crust as well as artificial sources include artificial radioactive substances and devices produce radiation. Naturally, there are three types of radioactive material in some parts in the world and on the surface and a depth, several meters. Potassium discovered during extraction of potassium hydroxide KOH in 1807 [1]

Potassium (K) is an alkali metal and its atomic number is 19. Potassium is soft and silver – white; easily oxidizes in the air, extremely interacts with water, produce heat, and thereby lead to ignite hydrogen and its reaction. This element forms approximately 4.2% of Earth's crust. It is the seventh most abundant element in the soil. Obtaining potassium from minerals is very difficult because of its insolubility and durability. Potassium and carbon, mainly, containing radioactive isotopes which has significantly high radiation dose. An average, Human has about 30 milligrams of potassium 40 that has a half life of 5730 years [2]. So far, 17 isotopes of potassium have been known. Non combinatorial form of potassium are composed of three isotopes: K-40 (93.3%), K-39 (0.01%) and K-41 (6.7%). It must be said that K-40 that naturally occurring, by electron capture and omission of positron converted to stable Ar-40.

A nucleus cannot decompose simultaneously with more than one type of radiation dose. Natural radioactive substances decompose as a result of sequentially decay. Natural sources of ionizing radiation such as alpha, beta, gamma, neutron and gamma photon existed since the creation of the world and now which has been a slight decrease over the centuries and much of their irradiation resulting from radioactive material in the earth's crust. The main source of natural radioactivity in the earth's crust which lead to large attract of radiation by living organisms is due to radio nucleotides in decay series U-238, Th-232 and radioactive radio nucleotides K-40 [3]. Normal radioactive substances and gamma rays in different areas depend on the geological and geographical conditions and environment and available at different values in each region of the world's soil. Regarding the population subjected to natural radioactivity due to gamma radiation is different in every region of the world, therefore, according to the various method of radiation measuring, identification and continuous control of activities where are at a higher level in terms of radioactive materials is essential [4]. Dadkhah and Nileye Ahmadi [5], radioactive substances are naturally expanded in the environment, although they are low

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density and are normally harmless. Soil naturally contains various radioactive materials some of which include uranium, thorium, radium and radon gas that continuously enters the atmosphere and have radioactivity. The major portion of the earth's crust consists of wastes with low level of radioactivity. Radiation of these waves no due to use of uranium for power generation only, but also, extraction of uranium from mines and its primary preparation for fuel cycle in case of uranium and any kind of other elements lead to human contact to these materials.

Riyazi and Tahghighi [6], during occurrence nuclear events trough wars and damages to nuclear installation, most important action, primarily, is lifesaving of injured and then remove infection from infected peoples. In this text, first introduction to most important radioactive elements in terms of nuclear contaminations and then summary about what should done as primarily clinical actions for infected people has been provided. Radiation leads to biological damages to body tissues trough direct and indirect ways. After contact of ionization rays to materials atoms, its a few or whole energy transfer and cause stimulation and ionization in site. Ionization can directly damage to structures and sensitive molecules in body cells that known as direct effect of radiation.

Azarvand [7], in determinant of natural radioactivity measurements in environmental samples of Sungun mining, Iran, showed that the amount radioactive elements, especially K40, in many parts of the region is higher than world average provided by UNICER (2000). According to biological effects of radiation on humans, the results are very important in terms of protection against radiation and health of those working in the mine. Rajesh *et al* [8], performed the study of k 40, 127 c transfer from Soils to food products. They conducted this transfer from soil to vegetables and dry forage by gamma technique. They harvested 31 soil, 21 vegetable and 22 dry forage samples from 23 different farms. They research showed that this samples are not in critical level. Macneill *et a* [9], proceed to the zoning of radio cesium levels in Ireland soils and performed study of its transfer from soil to potato plants. They study, using of gamma spectrophotometer analysis technique, showed that Ireland soils affected by Chernevil phenomenon and there is more than 88 percent of cesium, remained from Chernevil, in 1 – 10 cm of soil. The aim of this study is to determine potassium isotope 40 in Ardabil soil.

## MATERIAL AND METHODS

This study carried out to evaluate amount of potassium isotope - 40 in Ardabil soils in summer 2013. Sampling, randomly, take from soil of seven regions Karshenasan, Kowsar, Niar, Niar 1, Dash kasan, Shoorabil and Shoorabil 1, in Ardabil. Data needed obtained trough sampling and analysis of samples in the laboratory of the Atomic Energy Organization of Iran. For recording the sampling points, the location measuring device GPS is used. To prepare variables needed for related models, also, Excel soft ware is used. First, collected information introduce to working pages are created in the software and then calculations conducted to achieve variables in this study. After calculation of all variables need for this research model, these variables combined in working integrated pages to transfer electronically to the soft ware in final process. Permitted level, according to Idaho University, USA, is 400 kebel per kilogram that used in this study.

### Results:

**Table 1:** results from soil sampling from Ardabil soils.

Sample position	Gamma spectrometer	Result	Unit
Karshenasan	Soil radio nucleotide	877 ± 33	Bq / kg
Kosar	Soil radio nucleotide	812 ± 30	Bq / kg
Niar1	Soil radio nucleotide	984 ± 37	Bq / kg
Niar2	Soil radio nucleotide	857 ± 32	Bq / kg
Dash Kasan	Soil radio nucleotide	760 ± 28	Bq / kg
Shorabil1	Soil radio nucleotide	638 ± 24	Bq / kg
Shorabil2	Soil radio nucleotide	634 ± 24	Bq / kg

According to table 1, in all sampling regions, amount of potassium isotope 40 is higher than standard level of atomic energy, 457 kebel per kilogram.

**Table 2:** Discretion statistics of research variables

discretion statistics	potassium isotope
Number	7
Mean	794/57
Min	812
Mod	634
σ	128.04
Var	16395.29
Min	634
Max	984

The results of discrecional statistics of research variables showed that potassium isotope in sampling regions has average amount of 794.57, median 812, mode 634, SD 128.04, variance 16395.2, minimum 634 and maximum 984 kebel per kilogram.

#### Data normality test:

**Table 3:** Result of Kolmogorov – Smirnov test for data normality

Parameters	value
Maximum positive difference	0.18
Maximum negative difference	-0.15
Kolmogorov – Smirnov	0.48
Significant level	0.97

To assessment normality of independent variable distribution, Kolmogorov – Smirnov test used that its assumptions are following:

Null and Alternative hypothesis:

Data distribution is normal: H0

Data distribution is abnormal: H1

According to table 3, significant level of data is more than 5%; thus, we accept H1 assumptions. In other word, independent variable data distribution is normal.

T – Test

**Table 5:** T-test

	Number	Mean	Standard deviation	Mean Standard deviation
Value	7	794.57	128.044	48.39

**Table 5:** Test, according to Idaho university standard.

Portion value: 400					T - test	value
Degree of confidence		Mean difference	Standard deviation	Degree of freedom		
Highest	Lowest					
455.99	219.15	337.57	0.000	6	6.975	

According to Iran Atomic Energy, permitted level for isotope 40 is equal to 400 kebel per kilogram. Results of soil sampling from Ardabil showed that highest to lowest amount of isotope 40 belongs to Niar 1 (984), Karshenasan (877), Niar 2 (857), Kowsar (812), Dash kasan (760), Shoorabil 1 (638) and Shoorabil 2 (634), kebel per kilogram, respectively. As a result, each points of measurement represent the excess of permitted standard of Idaho University, USA. Niar (948 kebel per kilogram) and Shoorabil (634 kebel per kilogram) has highest and lowest infection, respectively.

#### Conclude:

To perform this study, seven kinds of soils from different regions evaluated that potassium isotope 40 radio nucleotides in this soils has average amount of 794.57, median 812, mode 634, SD 128.04, variance 16395.2, minimum 634 and maximum 984 kebel per kilogram. The results of this study shows that average concentration of potassium 40 in soils sampled from Ardabil is more than standard level of Atomic Energy.

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