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Detecting the Specific Activity of Isotopic Stable Radioactive in Soil and Plants Samples in Baghdad - Iraq

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Abstract

Recently, the focus of modern studies has been on pollution levels in urban areas, natural treatments, and long-term pollution prediction due to the effects that pollutants leave on the surrounding soil and plants for the purpose of providing a safe environment and increasing quality of life standards. The study was conducted in the sites that were exposed to events as illegal waste such as metal and isotope, soil samples were collected from ALbawia , ALbawia1000m and landfill, landfill 1000m in the middle of October 2023 and four types of plant collected from ALbawia1000m Eucalyptus camaldulensis , Phragmites Adans , Conocarpus lancifolius Eichhornia crassipes. Experimental setup of an HPGe detector to measure the specific activity of stable radioisotopes in soil samples and plants surrounding it Pb214,Pb212,228Ac,173Cs, 40K,Bi214, the results raying from 40K is 63 Bq/kg Pb214 is 2.24ppm Bi214 is 1.8 Bq/kg in ALbawia soil and 40K is 64 Bq/kg, Bi214 is 3.5 Bq/kg. Plant the results were Eucalyptus camaldulensis , Phragmites Adans , Conocarpus lancifolius Eichhornia crassipes of 40K are 89.96 ,153.64 , 47.76 , 153.46 Bq/kg respectively.

Keywords: Isotopic Stable Radioactive, Soil , Plants, Baghdad

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الكشف عن النشاط النوعي للنظائر المشعة المستقرة في عينات التربة والنباتات في بغداد / العراق

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المستخلص

في الآونة الأخيرة، انصب اهتمام الدراسات الحديثة على مستويات التلوث في المناطق السكنية والمعالجات الطبيعية والتنبؤ بالتلوث على المدى الطويل بسبب التأثيرات التي تتركها الملوثات على التربة والنباتات المحيطة بغرض توفير بيئة آمنة وزيادة جودة البيئة ومعايير الحياة. أجريت الدراسة في المواقع التي تعرضت للتلوث بالنفايات التي تحوي المعادن والنظائر، وتم جمع عينات التربة من الباوية والباوية 1000 م ومكب النفايات ومكب النفايات 1000 م في منتصف أكتوبر 2023 وأربعة أنواع من النباتات تم جمعها من الباوية 1000 م Eucalyptus camaldulensis، Phragmites Adans، Conocarpus lancifolius، Eichhornia crassipes. إعداد تجريبي لكاشف HPGe لقياس النشاط النوعي للنظائر المشعة المستقرة في عينات التربة والنباتات المحيطة بها Pb214,Pb212,228Ac,173Cs, 40K,Bi214 نتائج الأشعة من K40 هي 1.8 Bq/kg Bi214 2.24ppm, Pb214 63 Bq/kg ، في تربة الباوية وK40 يساوي 64 Bq/kg، Bi214 يساوي 3.5 Bq/kg . وكانت النتائج النباتية هي Eucalyptus camaldulensis , Phragmites Adans , Conocarpus lancifolius Eichhornia crassipes لـK40 هي 89.96 ، 153.64 ، 47.76 ، 153.46 Bq/kg على التوالي.

الكلمات المفتاحية: النظائر المشعة المستقرة، التربة، النباتات، بغداد

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Introduction

Science is developing all the time, and in recent years, more researchers have studied pollution control as a relatively new activity, especially in the biosphere, which is newly defined as a powerful approach directed mostly at new technology actively driven in the ecosystem within different areas and surroundings. Of plants or soil by surveying and monitoring risks [1]. Pollution

from a variety of sources harms plants. It could be water pollution, air pollution, land and soil pollution, or even the remains of human activities that affect the soil and plants, all of which are harmful to plants and living organisms in general [2][3]. Plant contamination can occur from water, air or soil contamination. There is a global focus on waste management and landfilling, and is able to deal with materials such as waste identification, export and transport licensing, labeling and packing, loading and transport, recovery, final treatment and disposal. Waste Management chooses the most appropriate treatment method for each type of waste in order to be able to find organic and inorganic contaminants in the environment. Heavy metals and radioactive materials are among the most accumulated materials causing environmental pollution [4]. Therefore, many studies have been conducted to study the treatment of plants affected by pollution to reduce the concentration and toxicity of pollutants from low-cost and readily available materials as environmentally friendly biological treatment and cost-effective metal removal and to predict future environmental risks, as recommended by the Environmental Protection Agency [5][6]. Exposure to high concentrations of this element accumulates in living organisms and leads to problems with survival radioactive substances, as well as radioactive decay occurs in alpha, beta, gamma and neutron radiation [7]. The degree of danger depends on the Tue of the energy released by the radiation and the proximity of the contamination to the organ. Radiation sources are naturally seen as cosmic rays and the Earth's crust, in addition to humans, by smoke detector manufacturers, which include nuclear energy and the active radio elements of medical x-rays. [8], it was examine soil and leaf plants surrounding it, that have occurred selected for being one of the most environmentally damaging areas of pollutant , so we choose plants (*Eucalyptus camaldulensis* , *Phragmites Adans* , *Conocarpus lancifolius Eichhornia crassipes*) and soil polluted with solid waste and waste water in general in the city of Baghdad , the main objectives of this study detecting the specific activity of isotopic stable radioactive in soil and plants samples with spatial analysis and half- life rate in study area.

Items of Research

2. Material and Methodology:

2.1 Samples collection: A-Soil Samples: Soil samples were collected from two sites, The first is a polluted stagnant water site and the sample were collected from the center of the site and about 1000 meters far, and the second is a landfill site and the sample were also collected from the center of the site and about 1000 meters far, each with three replicates, using cleaned polyethylene bags at a depth of 30 cm. A total of six soil samples were collected.

B-Plant samples: Before analysis, four leaves plants samples species were collected with three replicates of each sample, from polluted stagnant water soil (Albawia soil) , dried outdoors for 3-5 days at room temperature, ground with a grinder, and sieved with a 1 mm diameter strainer. There were four type Eucalyptus camaldulensis, Phragmites Adans, Eichhornia crassipes, Conocarpus lancifolius).

2.2 Radioactive Nuclides and Contamination in Plant and Soil

A : HPGe detector experimentation

The germanium crystal in the detector was exposed to gamma radiation, which caused the photon's

energy to be transferred to the atoms' electrons and the crystals to be expelled. Creates a pulse-forming pair of electrons and holes. Thus, the signal was passed by the detector as current. The signal, which was connected to a preamplifier, wasn't very strong. Preamplifiers' primary job was to boost the detector's weak signals and send them through the cable that connects them to the other pieces of equipment. It must add the least amount of noise while simultaneously converting the current into a current signal**.** Preamplifiers were positioned as close to the detector as feasible because the preamplifier's input signal was weak. The amplifier served two major functions when the signal moved from the preamplifier to the amplifier. Amplifying the signal from the preamplifier was the amplifier's primary function. The amplifier's second function was to modify the signal into a format that was useful for additional processing. The amplifier needs to maintain interesting data in both scenarios. The Analog to Digital Converter (gADC) records a continuous signal and generates a digital number that indicates the signal's amplitude.. An incoming pulse is sorted out and the number at each is counted by a multichannel analyzer. A summary was provided of the gamma ray spectrometry system's experimental setup and apparatus used in this investigation. Regarding the gamma-ray spectroscopy system's energy resolution, separate the two energy peaks to determine the resolution's FWHM (full width at half maximum).

B-HPGe detector setup for experimentation:

According to [9] state that a Canberra-based gamma spectrometry system is used for the measurements. It is equipped with a high purity (HPGe) type coaxial germanium detector that has a 30 percent relative efficiency for 137 ° and high accuracy (2.0 kV at 1332 kV). An 11.5 cm thick lead shield was placed around the detector to reduce background, and a 0.3 cm layer was added to attenuate the lead shield's x-ray emissions. The spectra were gathered in an SK MCA (1510 integrated data processor with S100 MCA scope and standard electronics) after the detector was connected., Canberra desktop inspector), as well as multiple gamma standard sources prepared in a marnilly beaker using the same geometry. Curves were created by correcting the experimental efficiencies for every sample density once the efficiency calibration was implemented. Efficiency curves take attenuation and absorption into consideration. The Certified Reference Materials (CRM) were used in the same counting geometry as the samples in order to test the linearity of the detectors using a mixed source from Canberra for Quality Assurance (QA). In order to correct the sample activities calculated, the background spectra 1s is often measured under identical conditions as the sample measurements. Every sample has an average counting time of 10800 seconds to guarantee statistical significance. Canberra's Genie 2000 software.

3. Results and Discussion

3.1 Isotopic stable radioactive study sites

In this part, has been revealed the specific natural activity isotopic stable radioactive anthropogenic on soil and plants samples using HPGe detector calculations.

3.1.1 Measurement the specific activity of isotopic stable radioactive in soil samples

Isotopic stable radioactive have been determined the soil samples within the criteria for determining the published values limited factor of global

proportions [10]The final concentration standard deviation and significantly was recorded in soil P-value ($P<0.05$). According to [11] and [12] who reported that the tiny isotopic stable radioactive were the primary pollution conditions would be higher than of the rough, in our results has been identified on the basis of natural environmental and source pollution factors affected from accumulation to stability in the soil Graphic images that were obtained and considered the entrance of the variables as an indicate a distributed the data by site and rate of pollution , from the start point time of pollution, a curve in one level and its stability is observed at the last point on a rate that may be considered the normal limit factors, graphic images in figure (1) spatial analysis activity of isotopic stable radioactive in soil samples oscillatory in more levels its stability last point with elevated quantities on in the graphic images in figure (2) it have a spatial analysis activity of isotopic stable radioactive samples that recorded higher levels of pollution were ultimately stabilized by a high extent of accumulation , that may be considered higher than the normal limit factors . It was clear the little level of unpolluted area , less than the polluted area , as the indicator starts to increase significantly at the first , then the accumulation stops for one level only ,the all graphic images of spatial analysis activity of isotopic stable radioactive in soil samples in all sites are shown in Figure (1) and Figure (2).

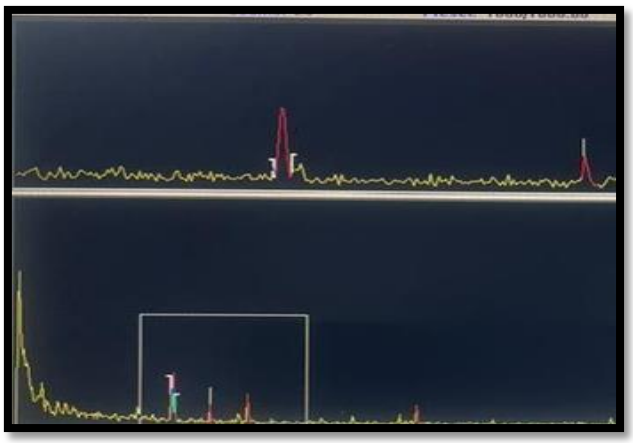

Figure (1): Graphic images of spatial analysis activity of isotopic stable radioactive in soil 1 samples

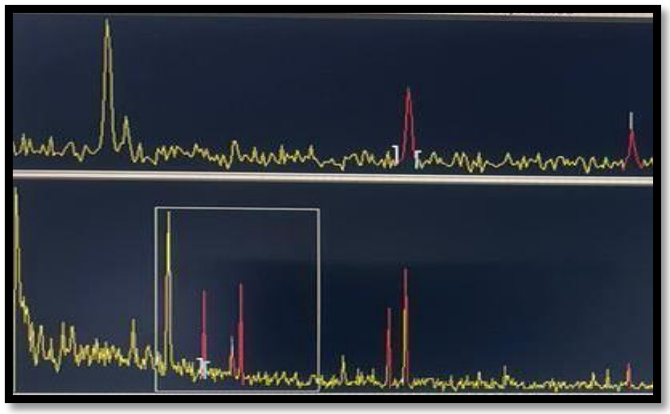

Figure (2): Graphic images of spatial analysis activity of isotopic stable radioactive in Soil 2 samples

So it can be seen the environmental indicators for a first level of pollution in graphic image including a variety of influence factor in soil, such as topography area , human activities and all the harmful releases to the surrounding environment, as a subsequent step through the process of spatial analysis and interpretation based on the environmental characteristics of the accumulation of radiation exposure as a result of the activities according methods [13][14]. Depending on the longitude and latitude that have been taken by GPS/ Geko 201,the geographic location of study area created by ArcGIS 10.5, https://www.arcgis.com/index.html, a graphical map of the spatial analysis to all half-life the elements variables of the study areas and after checking authenticity with all input data it has been applied to obtain the highest level of prediction in environmental factors quantitatively and qualitatively in study areas, the resulting according to the elements specific energy and spatial analysis activity of isotopic stable radioactive as shown in table (1) , (2) and figure (3).

Table (1): Specific Energy Isotopic Stable Radioactive in Soil 1

Elements	Energy	Activity	Half life	Yield
K40	1460.8	63	1277e+009y	10.67%
Bi214	6009.3	1.9	1600.01y	46.30%
Pb214	351.9	2.24	1600.01y	37.20%
Pb214	295.2	1.83	1600.01y	19.20%
Pb212	238.6	1.9	1.405e+010y	44.60%

Table (2): Mean Specific Energy Isotopic Stable Radioactive in Soil 1

Mean Puncture soil 1	Elements	*P value*
63	K40	0.02
1.8	Bi214	0.004
2.24	Pb214	0.002
1.83	Pb214	0.004
1.88	Pb212	0.004

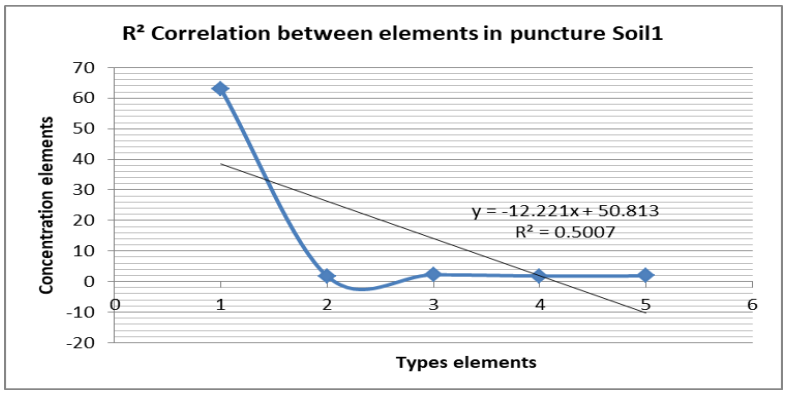

Figure (3): Specific Energy Isotopic Stable Radioactive in Soil 1

Based on observed spatial analysis for each elements of isotopic stable radioactive samples of all sites, examinations indicate that there is considered definite risk in future. That is evident was the spatial analysis have been showed a behavior elements and refers to the different distributions of concentrations , in general the distribution elements it was the most of the four sites for the elements (Pb214,K40,Bi214)and oscillatory the rest elements of conduct in the samples ,the results of (K40) in study site there were indicate significantly within high levels in all sites [S1(63) S2 (its value (0.04) Bq/kg respectively , more than acceptable limit which is estimate (100Bq/kg) by[15]which can be used as a tracer to infer elements by soil dynamics due not only to its long radioactive half-life as a most polluted with human activities risk high values of the radioactive isotopes.

Differences between data sets could be due to mechanical discharge of pollutants and portability accumulation in the soil, depending on active excretion with retention of radionuclide and omitted environmental factors in the simulations or in the derivations of the dilution with stable isotopes diffusive uptake in the organisms which was not included in the simulations , also it can be due to differences in environmental conditions between the conditions functional groups [16], soil samples may be used as an example to evaluate the extreme damage to prevent any accident aquatic ecosystems of the marshes and the result of radioactive decay in the soil and the liquidation of radionuclide in the bottom of water body, especially soil and sediments from possible pollution reduction, especially for most aquatic ecosystems components organisms and transmission to humans by food web. Also, the results according to the elements specific energy and spatial analysis activity of isotopic stable radioactive in Soil 2 are shown in table (3) , (4) and figure (4).

Table (3) Specific Energy Isotopic Stable Radioactive in Soil 2

Elements	Energy	Activity	Half life	Yield
K40	1460.8	48.226	1277e+009y	10.67%
Ac228	9691	1.62	1.405e+010y	16.60%

Bi214	6009.3	1.64	1600.01y	46.30%
Pb214	351.9	1.65	1600.01y	37.20%
Pb214	295.2	1.22	1600.01y	19.20%
Ti208	583	177.425	3.053	0.83%

Table (4): Mean Specific Energy Isotopic Stable Radioactive in Soil

Mean Puncture Soil 2 (1000m)	Elements	*P value*
48.226	K40	0.001
1.62	Ac228	0.0002
1.64	Bi214	0.0001
177.425	Ti208	0.06
1.065	Pb214	0.0001
1.22	Pb214	0.0002

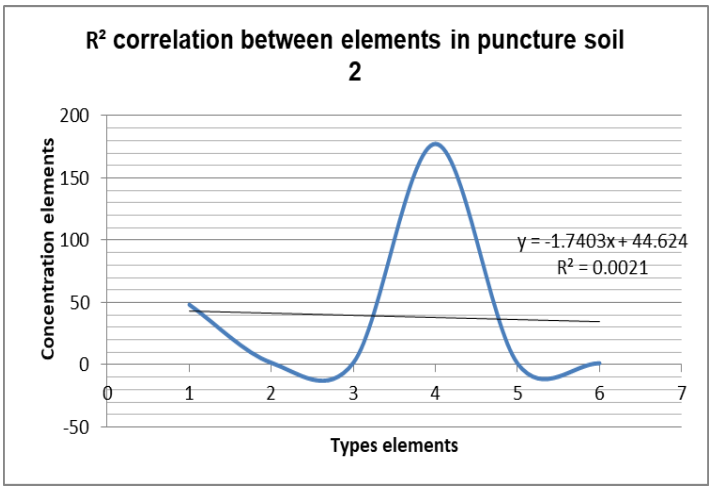

Figure (4): Specific Energy Isotopic Stable Radioactive in Soil 2

The results obtained from concentration of (Pb214)It was high in almost all sites [S1(2.24),S2(1.065) in and S1(1.83), S2 (1.22)]Bq/kg Respectively ,when compared with [17] which came up with an activity more than (0 – 6.3 Bq/kg) and reported in [18] the percentage consider a high level in our sites, the input and output effective dose due to natural radioactivity that may be due to the increase of the level of organic material or decomposition stages the content of material and modification implies the perturbations on soil density contributes to the small immobilization of Pb 214 in organic part and hence to its higher availability Pb isotopic stable radioactive exposure in soil content , this samples may be used as an example to evaluate the extreme damage to prevent any accident ecosystems pollution of nature. It is possible to

calculate the half- life rate for each of the values Pb214 element and distribute to site[S1(37.20%),S2 (37.20%), and S1(19.20%), S2(19.20%)]Bq/kg respectively.

The results obtained indicate a relative increase (Bi214) in sites (S1and S2) the range of activity concentrations is comparatively of more values in samples (1.9, 1.64)Bq/kg respectively , as compared to world average from the study site more than the permissible value (37 Bq /kg),and more than (3.2-10.2 Bq/Kg) [17]That correspond to the values are reported by [19][20]these values reported for radium content in sediment of study area are generally high, this results may be due to the unsanitary activities followed in the region and the waste of sewerage materials. It is possible to calculate the half- life rate for each of the values Bi214 element and distribute to sites [(S1(46.30%),S2(46.30%),andS1(15.80%),S2(46.30%)] Bq/kg respectively. From the data obtained standards there was an effect that depends on the type of radiation produced by representing half-life of radioactive radiation due the disintegration of an internal source. Normal level detected Isotopic Stable Radioactive cesium 137, which has a longer half-life and produces higher radiation, replace completed Cs 137 less harmful in environmental concerns. The results of 40K activity of Isotopic Stable Radioactive in Soil Samples concentrations in the collected soil samples. Average ranges of activity concentration there were not concentration a rather high and indicate there normally from natural sources contrary to the results of previous studies was up to the highest of 50 Bq/ kg [18][21].

For all sampling station the 228 Ac correlations less level, altitude and soil density were found. It is well documented, that soil properties are altered with the altitude, particularly the features of upper soil layers, Average and the ranges of activity concentration of 228Ac in soil sampling has been less than reported in [22][18][23]. The results obtained from concentration of Pb212, Pb214 and Pb 138 in soil samples of area are higher than the world figures reported in [18], the indoor and outdoor effective dose due to natural radioactivity, that may be due to the increase of the level of organic material in the surface soil layers or decomposition stages the content of material and modification implies the perturbations on soil density, contributes to the small immobilization of radio cesium in organic part of soils and hence to its higher availability Pb Isotopic Stable Radioactive exposure in soil content [15]. In this context the relation between soil and Pb212, Pb214, Pb138 concentration reflects the interdependence between the altitude and soil content concentration. Radioactivity lead isotope stability that comes from disintegration for both emitters' gamma and presented relation of density volume in the soils. The results indicate that there was no significant correlation between the concentrations of radioactive elements with the soil that is with values of Pb 212, Pb 214 per Isotopic Stable Radioactive it was possible to estimate the concentrations in all components of soil ecosystem are higher than the comparison Pb 212, Pb 214. All the values of materials are shown in table (5) and the correlation between elements and landfill soils are shown in Figure (5) and Figure (6).

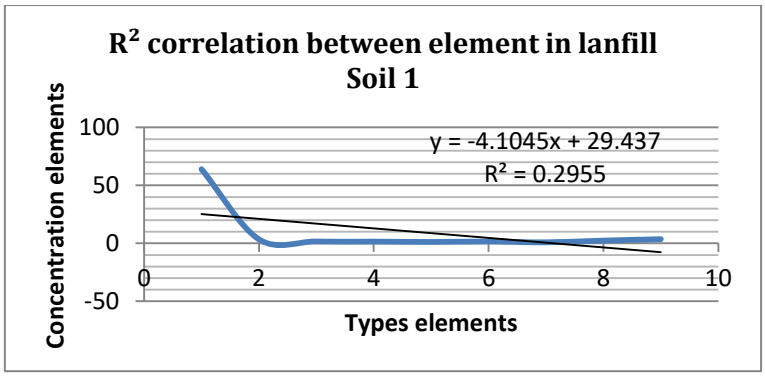

Figure (5): Specific Energy Isotopic Stable Radioactive in Landfill Soil 1

Table (5): Mean Specific Energy Isotopic Stable Radioactive in Landfill Soil 2

Elements	Mean Landfill Soil 2 (1000m)	*P value*
K40	62	0.02
Ac228	1.2	0.002
Bi214	1.2	0.001
Pb214	1.18	0.001
Pb214	1.02	0.001
Pb212	0.82	0.002
Ra226	3.2	0.0001
Sc137	0.04	0.003

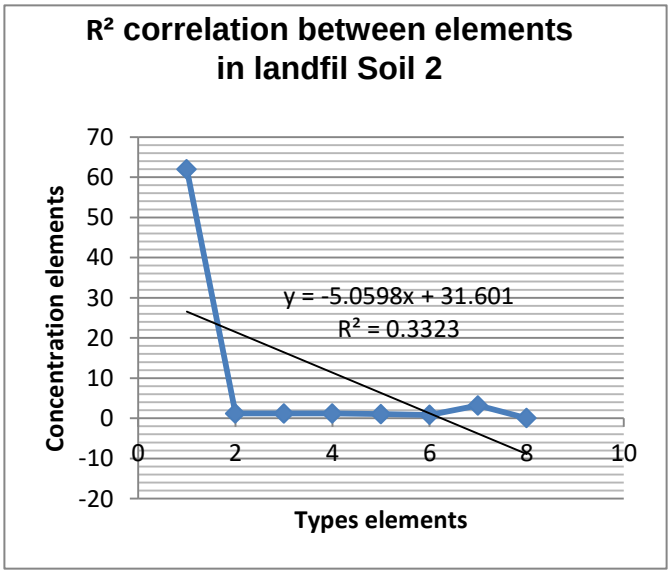

Figure (6): Specific Energy Isotopic Stable Radioactive in Landfill Soil 2

3.1.2 Measurement the specific activity of isotopic stable radioactive in plants samples

Through the results, the concentration of radioactive potassium in plants. The results

recorded that the highest value of radioactive potassium is in the reed plant and the Nile flower, because these plants grow in the middle of stagnant water, which is considered sewage from homes, and this water contains waste radioactive materials. This includes radioactive potassium, and occurs as a result of the bioaccumulation of radioactive elements in plants. Nile flower plants are distinguished by their great ability to withdraw very large quantities of water, and thus contribute to ridding the environment of the danger of radioactive elements, as well as the reed plant. According to [24] the varation of K40 radioactive element in all types plants is shown in Table (6) and figure (7).

Table (6) the varation of K40 radioactive element in all types plants

Plant species	K40
Conocarpus	47.76
Reeds	153.64
Nile flower	153.46
Eucalyptus	89.96

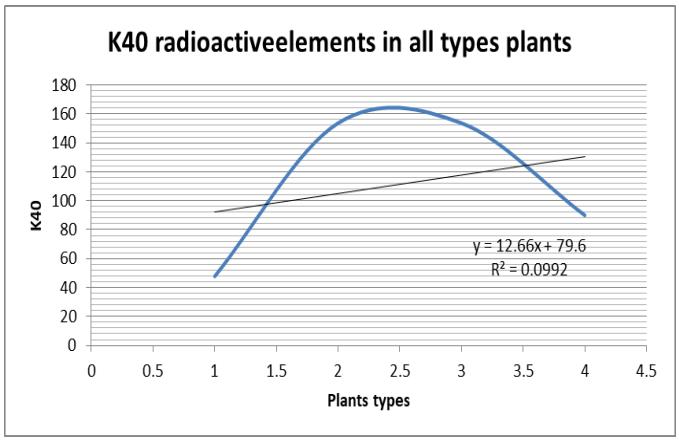

Figure (7): The variation of K40 radioactive element in all types plants

Conclusions

The results of radioactive and isotope were within allowable standards limits. They were 47.76, 153.64, 153.46, 89.96 Bq/kg in plants and K40 is 63, Pb214 is 2.24, Bi214 is 1.8, Ti208 is 177.425, Cs137 is 0.4 consecutively, and demonstrated levels of radioactive in soils are K40 is 63, Pb214 is 2.24, Bi214 is 1.8, Ti208 is 177.425, Cs137 is 0.4. This suggest greater risk for organisms living in the area especially human beings and focusing on sites that contaminated with heavy metals or radioactive to determine their effects on soil water or organisms living in their areas.

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