Measurement the natural radioactivity of fertilizer paradigms by utilizing (HPGe) detector

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Abstract

The specific activity in 10 fertilizer paradigm in five types of fertilizer (M.F), paradigm (O.N.), paradigm (T.S.P), paradigm (S.S.P) and paradigm Urea },then found the specific activity by utilizing (HPGe) detector.The results obtained have shown that the max value A_U and A_{Th} in (T.S.P), Lebanese origin, which was equivalent (28.660, 30.470) Bq/kg , respectively.

Keywords: fertilizer paradigms, specific activity, (HPGe) detector.

قياس النشاط الإشعاعي الطبيعي لعينات السماد باستخدام كاشف (HPGe)

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الخلاصة

في العمل الحالي، قمنا بقياس الفعالية الاشعاعية في عشر عينات سماد في خمسة أنواع من السماد العينة **(MF)**، والعينة **(ON)**، والعينة **(TSP)**، والعينة **(SSP)** العينة يوريا، ثم وجدنا الفعالية الاشعاعية باستخدام كاشف الجرمانيوم عالي النقاوة أظهرت النتائج التي تم الحصول عليها أنه تم العثور على أعلى تقدير لـ A_U و A_{Th} في عينة **(TSP)**، من أصل لبناني، والتي كانت تساوي (٢٨.٦٦٠، ٣٠.٤٧٠)Bq/kg على التوالي.

الكلمات المفتاحية: عينات السماد، الفعالية الإشعاعية، كاشف **(HPGe)**.

Introduction

Radioactivity in natural fertilizers, whether in Organic or Organic, is just too vulnerable is just too vulnerable but it can not be ignored, while in chemical fertilizers the radioactivity varies according to the constituent elements of these fertilizers. Most chemical fertilizers include of substances containing nitrogen, ^{40}K and phosphorus. Nitrogen includes radioactivity that may be not noted. Phosphorus consists of concentrations of ^{232}Th and ^{238}U decay products. Most of phosphate rocks almost (80%–90%) are considered the raw source of phosphate fertilizer manufacture [1]. The last element, K-40, contains small amounts of ^{40}K. The ^{238}U is a phosphate companion, therefore phosphate fertilizers contain high

concentrations of uranium compared to other types of fertilizers [2]. These radionuclides may be absorb by plants and transported to their edible parts, which become a supply of inner exposure to the organism [3]. Fertilizers are hugely used to enhance yield of the crop by means of helping nutrient reserves in soil, however, these fertilizers interfere with chemical, biological and physical properties of the soil [4].

1. Collection and Preparation of the paradigm

Ten paradigms of inorganic and organic fertilizers are collected from different Iraqi agricultural offices. The fertilizer paradigms were squashed to little pieces (fine powder) by utilizing electrical mill, then about of (750g) and (300µm).

Determination of some Gamma Radiation Parameters

1-Activity Concentration [5]:

$$A = \frac{NET}{\varepsilon * I_\gamma * m * t} \quad \text{..... (1)}$$

2- Radium Equivalent (Ra_{eq})[5]:

$Ra_{eq} = (0.077A_K) + (1.43A_{Th}) + (A_U)$

Where:

A_K, A_U and A_{Th} are the concentrations specific activity of ^{40}K , ^{238}U and ^{232}Th respectively.

3- Absorbed Dose Rate (D_γ) [6]:

D_γ (nGy/h) = $0.0417A_K + 0.604A_{Th} + 0.462A_U$

4-Annual Effective Dose Equivalent [7]:

$(AED)_{in} = D_\gamma \times 10^{-6} \times 0.80 \times 0.7 \times 8760$ h/y

$(AED)_{out} = D_\gamma \times 10^{-6} \times 0.20 \times 0.7 \times 8760$ h/y

5-External (H_{ex}) and Internal (H_{in}) Hazard Indices [8]:

$$H_{in} = \left(\frac{A_u}{185}\right) + \left(\frac{A_{Th}}{259}\right) + \left(\frac{A_K}{4810}\right)$$

$$H_{ex} = \left(\frac{A_u}{370}\right) + \left(\frac{A_{Th}}{259}\right) + \left(\frac{A_k}{4810}\right)$$

6-Activity gamma Index (I_γ) [9]:

$$I_\gamma = \frac{A_u}{300} + \frac{A_{Th}}{200} + \frac{A_K}{3000}$$

Outcomes and Discussion

Ten paradigm from various types of fertilizer was available in the local emporium, the countries like, (Lebanon, Iran, Jordan and Iraq) in the five types of fertilizer {Urea, mixed fertilizer (M.F),organic nitrogenous(O.N.), ,single super phosphate (S.S.P) and triple super phosphate (T.S.P)} ,then found the specific activity by utilizing (HPGe detector).

In Table (1) and Fig.(1) see that: The A_{Th} and A_U was in paradigm triple super phosphate (T.S.P), Lebanese origin, was equivalent (28.660 $^{Bq/kg}$, 30.470 $^{Bq/kg}$) , while the least estimation of A_U and A_{Th} was found in paradigm organic nitrogenous (O.N.), Jordanian origin,which was equivalent (13.470 $^{Bq/kg}$, 17.550 $^{Bq/kg}$), with a rate estimation of (20.785±3.6 Bq/kg and 24.695±3.3 Bq/kg), respectively. The present outcomes have demonstrated that estimations of A_U and A_{Th} in fertilizer paradigms were value of (35 $^{Bq/kg}$ and 30 $^{Bq/kg}$), respectively[10].

The highest value of A_k was found in paradigm (T.S.P), Jordanian origin which was equivalent (276.820 Bq/kg), while the least estimation of A_k was found in paradigm Urea Iraqi origin which was equivalent (133.820 Bq/kg), with a rate estimation of (210.336±42.8 Bq/kg). were value of (400 Bq/kg) [10].

The parameters [Ra_{eq} ,D_Y , $(AED)_{in}$,$(AED)_{out}$, H_{in} , H_{ex} and I_γ] was found in paradigms triple super phosphate (T.S.P), Lebanese origin which was equivalent (90.985 Bq/kg, 41.800 Bq/kg ,0.205 Bq/kg,0.051 Bq/kg, 0.323 Bq/kg, 0.246 Bq/kgand 0.329 Bq/kg),,while the parameters [Ra_{eq} ,D_Y, $(AED)_{in}$, $(AED)_{out}$, H_{in} and I_γ] was found in paradigms Urea Iraqi origin which was equivalent (55.249 Bq/kg, 25.176 Bq/kg ,0.124 Bq/kg,0.031 Bq/kg, 0.149 Bq/kg and 0.199 Bq/kg), while the least estimation of parameter H_{ex} found in paradigm organic nitrogenous (O.N.),Jordanian origin, which was equivalent to (0.188 Bq/kg), with a rate estimation of (72.295±10.4 Bq/kg ,33.289±4.7 Bq/kg ,0.163±0.02 Bq/kg, 0.041±0.006 Bq/kg ,0.251±0.03 Bq/kg,0.195±0.02 Bq/kg and 0.263±0.03 Bq/kg).The (T.S.P) it has more radioactivity than other types of fertilizers because phosphate rocks have a large amount of natural ^{238}U.

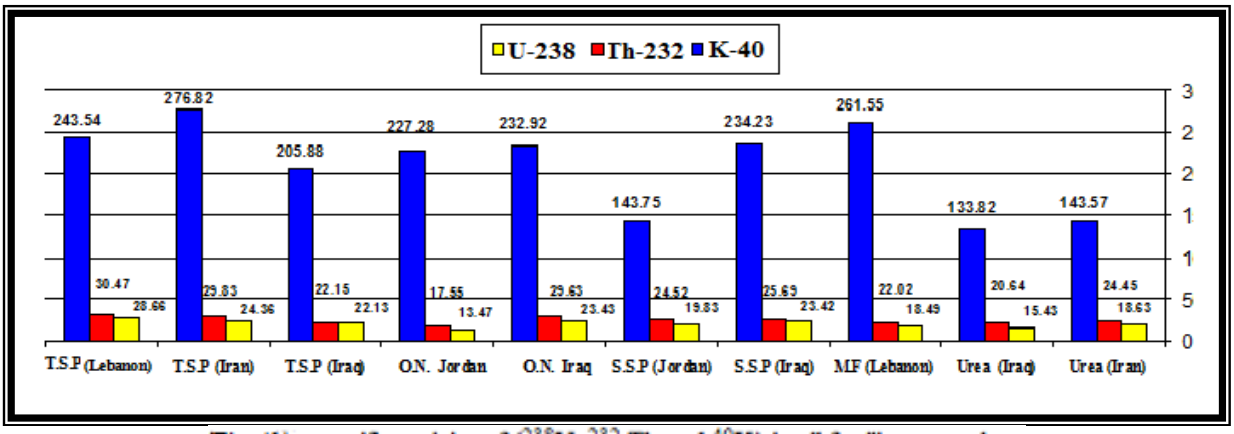

Fig.(1) specific activity of (^{238}U, ^{232} Th and ^{40}K) in all fertilizer samples.

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Table (1) specific activities of U-238, Th-232 and K-40 with some other parameters [Ra_{eq} ,D_Y , $(AED)_{in}$,$(AED)_{out}$, H_{in} , H_{ex} and I_γ] in fertilizer samples.

Paradigm type	Origin	^{238}U	^{232}Th	^{40}K	Ra_{eq}	D_γ	(A. E. D)		H_{in}	H_{ex}	I_γ
							Indoor E_{in}	Outdoor E_{out}			
Urea	Iran	18.630	24.450	143.570	64.648	29.362	0.144	0.036	0.225	0.175	0.232
Urea	Iraq	15.430	20.640	133.820	55.249	25.176	0.124	0.031	0.191	0.149	0.199
(M.F)	Lebanon	18.490	22.020	261.550	70.118	32.749	0.161	0.040	0.239	0.189	0.259
S.S.P	Iraq	23.420	25.690	234.230	78.192	36.104	0.177	0.044	0.274	0.211	0.285
S.S.P	Jordan	19.830	24.520	143.750	65.962	29.966	0.147	0.037	0.232	0.178	0.237
O.N.	Iraq	23.430	29.630	232.920	83.736	38.434	0.189	0.047	0.289	0.226	0.304
O.N.	Jordan	13.470	17.550	227.280	56.067	26.301	0.129	0.032	0.188	0.151	0.208

T.S.P	**Iraq**	**22.130**	**22.150**	**205.880**	**69.657**	**32.188**	**0.158**	**0.039**	**0.248**	**0.188**	**0.253**
T.S.P	**Iran**	**24.360**	**29.830**	**276.820**	**88.332**	**40.815**	**0.200**	**0.050**	**0.304**	**0.239**	**0.323**
T.S.P	**Lebanon**	**28.660**	**30.470**	**243.540**	**90.985**	**41.800**	**0.205**	**0.051**	**0.323**	**0.246**	**0.329**
Avr.		**20.785±3.6**	**24.695 ±3.3**	**210.336 ±42.8**	**72.295± 10.4**	**33.289± 4.7**	**0.163 ±0.02**	**0.041 ±0.006**	**0.251 ±0.03**	**0.195 ±0.02**	**0.263 ±0.03**
Min.		**13.470**	**17.550**	**133.820**	**55.249**	**25.176**	**0.124**	**0.031**	**0.188**	**0.149**	**0.199**
Max.		**28.660**	**30.470**	**276.820**	**90.985**	**41.800**	**0.205**	**0.051**	**0.323**	**0.246**	**0.329**
World wide rate [10]		**35.00**	**30.00**	**400.00**	**370.00**	**55**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

2. Conclusions

The values of specific activity for (^{232}Th, ^{40}K and ^{238}U) and determination the parameters ,all were found to be minimum than the corresponding allowed, and hence will be pose relatively none the health risk.

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