Assessment of Natural Radio Activity Level in Some Imported Food Products in the Iraq Markets

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Abstract

The current study includes the evaluation of the levels of natural radioactivity of some nuclei in food samples included of 12 rice, and 8 legumes. Local markets in the Iraqi city of Hilla were sampled and spectral measurements were carried out using the reagent system sodium activated iodide thallium (NaI (Tl)) (3 3). ^{238}U (^{214}Bi), ^{232}Th, and 40K had average values of (16,580.5278, 20,241.0849), and (388.87023.0914, respectively) of Bq/kg in rice samples, according to the study. (^{214}Bi), (^{232}Th), and ^{40}K were all within the range of samples of legumes (7.46), (20.68) (322.57). All these results for the average specific activities of ^{238}U(^{214}B), ^{232}Th and ^{40}k were compared with the limits recommended by UNSCEAR (32)Bq/kg for specific activity of ^{238}U (^{214}B), (45)Bq/kg for specific activity of ^{232}Th, (412)Bq/kg for specific activity of ^{40}K and found to be below those values. Also, it was found that, the internal hazard index were (0.243) Bq/kg in samples of rice and the Extranl hazard index were(0.194 these results for the average value of the internal hazard index were compared with the limits recommended by UNSCEAR (1) for internal hazard index and found to be below those values. Accordingly, most of the food models that examined are considered honest in terms of contamination of nuclear radiation naturally.

Key Words: Radio Activity, Food Products, Local Market.
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Introduction

The increasing use of radioactive sources in our daily lives may increase the risk of radioactive pollution and exposure to radiation (Viruthagiri G. and Ponnarasi et al, 2011). There is a consequent requirement for knowledge of methods for estimating the Increase inradioactive elements and the measurement of radioactivity in food samples was observed There are a number of international and local studies that point to the presence of match potassium in ^{40}K as a sign of radioactive contamination. The oldest plant known to man, legumes, is the source of all food samples, as well as the consumption of legumes in exports. It's rice and legumes that play the most important role in human diets; rice has overtaken grains as the second most important food, and legumes are a major source of protein and calcium in countries with slower economic growth. An increasing number of European and American farmers are cultivating a variety of legumes, including the more well-known black bean, chickpea, lentil, and corn varieties. With deep roots and Ozon-rich soil, legumes serve the soil by making it more fertile. The dense cultivation also prevents weeds from growing, making it easier for the soil to absorb nutrients and making it healthier.

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Natural radioactivity from ^{238}U, ^{232}Th, and ^{40}K in some legumes available in Iraqi markets was measured to determine their annual effective dose for K-40 element to human over 17 years old, their radium equivalent, and the internal hazard of gamma radiation so that you can compare their concentration indices to the acceptable limit of each.

In nature, radionuclides can be found in the soil, drinking water, and even in our food. These radionuclides have half-lives that are at least as old as the Earth itself (i.e. about 4 to 5 billion years). Earth and the atmosphere contain a variety of naturally occurring radioactive decay series (like ^{238}U and ^{232}Th) and single-occurring radionuclides, such as ^{40}K. 1 Airborne radioactivity, as well as that found on and in agricultural land and soil, can contaminate the crops that are raised there. Radiation affects water and soil, which can then reach plants and animals, and eventually humans, through the food chain (Vosniakos, 2012). Some background radiation is caused by natural sources of radiation in the atmosphere (Knoll, 2010; Tsoulfanidis, 2010). In light of the above, further research is needed into the effects of radiation on detection. There are several steps that must be taken in order to properly clean up pollution in our environment. Numerous studies and techniques have been developed to determine radioactive material concentrations in soil, water, air, building materials and food and plants. NaI (Tl), HpGe detector, solid state nuclear detectors (SSNTDs), Geiger-Muller counter system, and fluorescence measurements were used in the gamma ray spectrometry (Gamma Ray Spectrometry) X-Ray Fluorescence Spectroscopy and Neutron Activation Analysis are used to determine pollution levels (Baykara and Dogru, 2006). fertilized soils and crops have a greater concentration of naturally occurring radioactive elements because of the effect of fertilizer (Liesel, 2005). Ionization of cell atoms can result from nuclear radiation that enters the organism's body. Natural ingredients such as milk, starch, eggs, and other naturally occurring substances contain these radioactive materials. Several international studies have been conducted using Kama spectra, such as sodium iodide reagent, to examine the radioactivity of canned and ready-made foods in Iraqi markets (Abojassim et al., 2014, 2015, 2016a, b). Because they are consumed by people of all ages, the current study aims to determine the natural radioactivity levels in selected samples of Iraqi rice and samples from the country's local markets. It was discovered that Sodium Iodide Doped Thallium (NaI) could be used to measure the specific activity of radioactive nuclides such as 238U, 232Th, and 40K (Tl). In this study, we also calculated the radium equivalent and the internal hazard index.

Materials and Methods

The process of preparing and gathering samples. More than a dozen types of locally grown rice were collected from markets in Iraq and dried for 1 to 3 hours at 50 to 350 degrees Fahrenheit in order to avoid any moisture sorption; then, the dried samples were ground and processed using a mixer to ensure that all of the particles are of the same size. In order to apply NaI(TI) spectroscopy, equal portions (0.75 kg) of each rice sample were taken using a highly sensitive digital weighing balance with a percentage of 60.01 percent and placed in containers for 20 days in Marinelli beakers to achieve equilibrium between the isotopes of natural decay series. It was decided to divide the samples into groups. In accordance with a representative code, trademark, and source (Table. 1.).

Experimental Setup

This research was carried out using Ortec (Oak Ridge, TN) Gamma Spectrometry systems with a scintillation detector NaI(TI) (three-quarters of an inch, or 7.6 centimeters, in size) and an 8 percent resolution for 137Cs (661.7 keV). Background radiation from the lead shield was reduced by shielding the detector (5cm thick) with copper (0.3cm thick) so that X-rays emitted by the lead were blocked. We used an integrated data processor 1510 with an S100 multichannel analyzer band to connect the detector to a spectrum analyzer and other necessary electronic equipment (InSpector portable spectroscopy workstation, Canberra Industries, Meriden, CT). A gamma standard was used to calibrate the energy.

A source that was prepared in the same way as the samples that were analyzed. A background spectrum was measured under identical conditions to the sample measurements before any data were recorded for each sample activity. In order to get more accurate results, the counting time for each sample was set at 14400 s using a highly sensitive digital weighing balance with a percentage of 60.01 percent; samples were sealed in Marinelli beakers for a period of 20 days to achieve equilibrium between the isotopes of natural decay. Sample codes, trademarks, packing dates, and origins were used to categorize the series samples (Table 1) (Table 2).

Table 1. Sample code, name of sample, orgin and packing date

S	Names Sample	Origin	Packing date
R1	Joker	India	04\2021
R2	Gul Bahar	India	01\2021
R3	Fetnam	Fetnam	04\2021
R4	Elegant	India	04\2021
R5	Abo Hosan Gold	India	02\2021
R6	Tiland Rice	Tiland	04\2021
R7	Sella Rice	India	07\2021
R8	Royal Stallion	India	04\2021
R9	Bashan	India	06\2021
R10	Abu Eagle	India	04\ 2021
R11	Saman	Aourgwi	01\2021
R12	Mahmood Rice	India	04\2021

Table 2. Sample code, name of sample, orgin and packing date

Sample Code	Names Sample	Origin	Packing Date
B1	White Beans	Canada	01/.2021
B2	Alt Unsa Beans	Argention	0.4/2021
B3	Nawras Beans	Argention	0.9/2020
B4	Cowpeas	Madagascar	11/2020
B5	Cowpeas	Russia	01/2021
L1	Red Lentils	Canada	12/2020
L2	Green Lentils	Russia	4/2021
L3	Zer Lentils	Canada	12/2020

Calculations

The ability to focus one's attention on one's activities A specific activity's Activity Concentration (A) can be determined using the following formula s. (Pourimani and Mortazavi-Shahroudi, 2018, Abojassim, 2019):

$$A=\frac{N_{net}}{\varepsilon.I_{\gamma}.M.t}\pm\frac{\sqrt{N_{net}}}{\varepsilon.I_{\gamma}.M.t}\,[\mathrm{Bq/kg}] \qquad (1)$$

The Nnet, exactly where are we? (kg) t: measurement time per unit (kg) net area under curved optical peak () calculated efficiency of kami linmodel (sec).

Table 3. Specific Activity of ^{40}k, ^{238} U and ^{232}Th Natural radioactivity in some types of rice

S	^{40}k	^{238}U	^{232}Th
R1	346.70±25.1186	10.79±0.4755	11.57±0.7875
R2	358.55±11.866	9.78±0.4258	12.91±0.8318
R3	381.86±26.315	19.17±0.6337	22.93±1.1085
R4	346.07±25.0955	25.62±0.2325	24.70±1.1504
R5	409.76±27.3075	8.44±0.4206	21.70±1.0783
R6	356.13±25.4578	6.10±0.3575	25.07±1.1591
R7	411.93±27.3075	22.10±0.6805	25.98±1.8005
R8	358.68±25.5487	12.63±0.5128	16.02±0.9265
R9	405.68±27.1713	30.56±0.800	17.95±0.9807
R10	430.01±28.0115	22.86±0.6920	21.80±1.0810
R11	374.17±26.2116	10.68±0.4508	16.50±0.9403
R12	455.91±28.947	20.34±0.6528	25.77±1.1751
AV	388.870±23.0914	16.58±0.5278	20.24±1.0849

Table 4. Specific Activity of ^{40}k, ^{238} U and ^{232}Th Natural radioactivity in some types of legumes

S	^{238}U	^{232}Th	^{40}k
B1	3.00±0.2507	28.45±1.2347	406.10±2.7185
B2	6.70±0.3748	19.82±1.0307	424.08±2.7780
B3	6.28±0.3629	20.89±1.0581	426.0±2.7843
B4	5.82±0.3494	17.68±0.9733	397.77±2.6904
B5	8.55±0.4232	18.00±0.9822	407.52±2.7232
L1	8.19±0.4143	19.45±1.0209	311.91±2.3824
L2	7.46±0.3953	20.68±1.0527	322.57±2.4228
L3	7.44±0.3948	14.19±0.8722	296.55±2.3230
AV	6.68±0.3706	19.89±1.0281	335.07±2.6028

Rice samples' natural radioactivity is usually determined using ^{238}U, ^{232}Th, and ^{40}K content, which reduces the scattering radiation from the interaction of radiation in the sample with shielding. Radiation levels for ^{232}Th,^{40}K, and ^{238}U were determined using the (EC & ORTEC) program, and the sample was placed in the middle of the room shield for a period of about (14400 sec). There is a 99 percent chance that ^{238}U and ^{232}Th have the same specific activity as ^{208}Tl, and a 15.96 percent chance that ^{214}Bi has the same specific activity as ^{238}U as measured by the 1460-keV gamma-ray line (11 percent chance), whereas the activity of ^{40}k was calculated using a different method. According to this formula (which measures specific activities in curies per kilogram), U-235, 232, and 40 were tested for their specific efficacy, and the following risk parameters were measured: It is used to determine the level of risk or exposure. calculated specific activities in kilograms of curies by the following risk parameters were determined based on the specific efficacy of uranium238, thorium-232, and potassium-40: The radium equivalent, denoted by Ra _eq and measured in Bq/kg, is a unit of measure for estimating the level of radioactivity present in uranium 238 (^{235}U), thorium 232 (^{232}Th), and potassium 40 (^{40}k), and can be calculated as follows:

$$Au+1.43Ath+1.77Ak \ (2)$$

WHERE: AK; ATh; AU Urea, Thorium, and Potassium should all be less than 370 Bq/kg, and Ra eq should also be less than that (OECD, 1979). Short-lived isotopes, such as radon, radium, and thorium t, emit alpha particles, which are then followed by variously energetic gamma rays as they enter the body. It is possible to mitigate this risk by using the internal risk index (Hin). For this to apply, it must be less than one to be within the internationally permissible limits (UNSCEAR, 2000).

$$H_{in}=(\frac{A_u}{185})+(\frac{A_{th}}{259})+(\frac{A_k}{4810}) \ (3)$$

The calculation shows specific activity for rice ranged from 346.70±25.1186 to 455.91±28.947 with average 388.870±23.0914 for ^{40} K and for rice ranged from 6.10±0.3575 to 30.56±0.8 with average 16.58±0.5278 for ^{238} U and ranged from 11.57±0.7875 to 25.98±1.8005 with average 20.24±1.0849 for ^{232} Th. and the calculation shows specific activity for legumes from 296.55±2.3230 to 424.08±2.7780 with average 335.07±2.6028 for ^{40}k and ranged from 3.0±0.2507 to 8.55±0.4232 with average 6.68±0.3706 for ^{238}U and ranged from 14.19±0.8722 to 28.45±1.2347 with average 19.89±1.0281 for a total of 232 Kama ray intensity (m) and sample mass (I) were calculated for various energies.

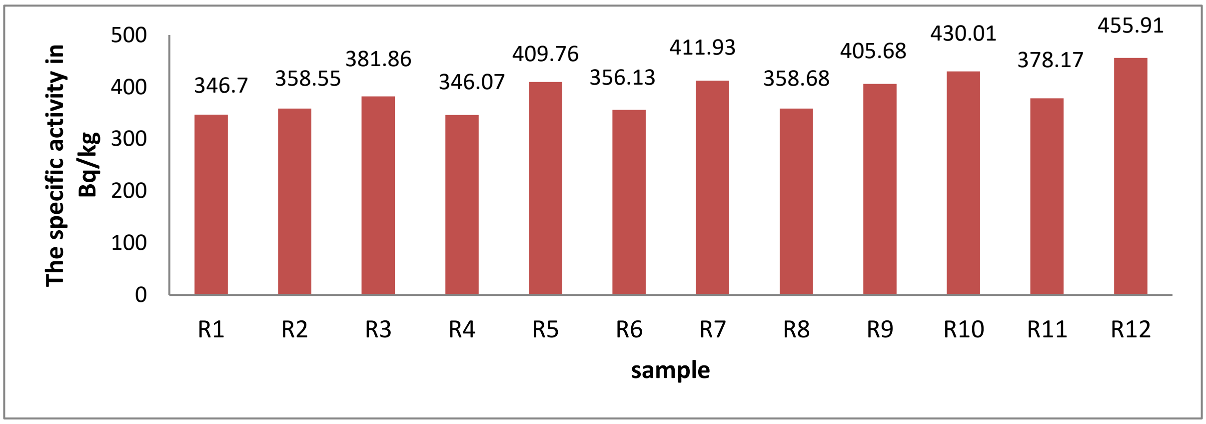

Fig. 1. Specific activity of ^{40} k for different types of rice from Iraq markets

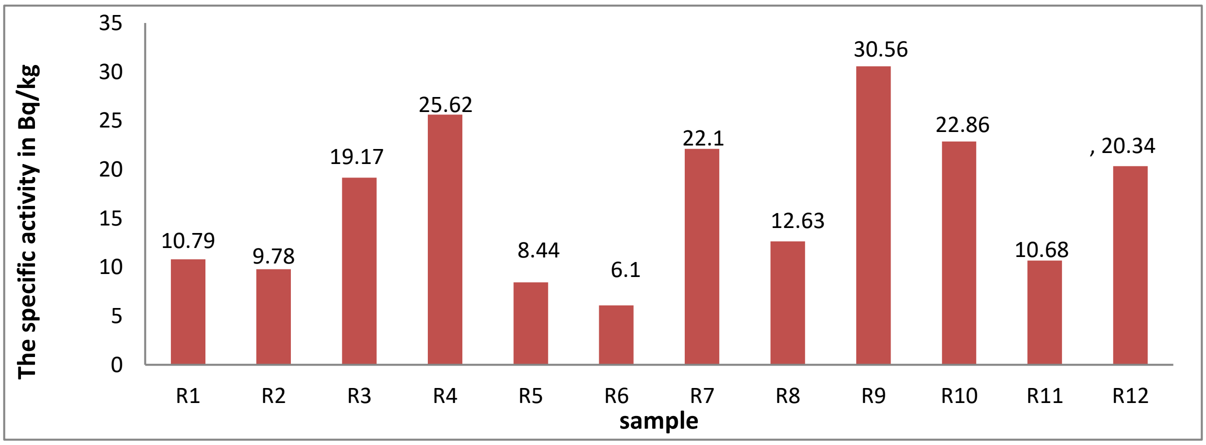

Fig. 2. Specific activity of ^{238} U for different types of rice from Iraq markets

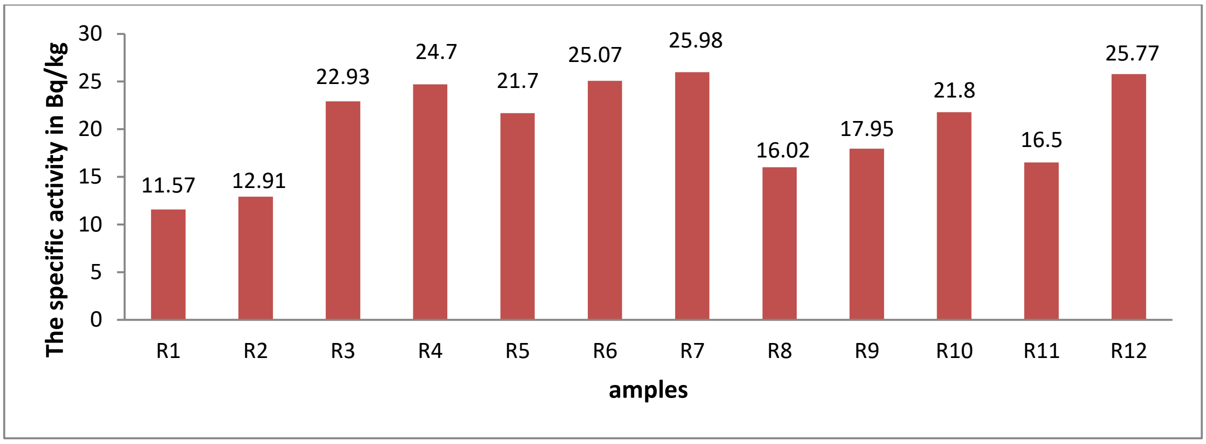

Fig. 3. Specific activity of ^{232}Th for different types of rice from Iraq markets

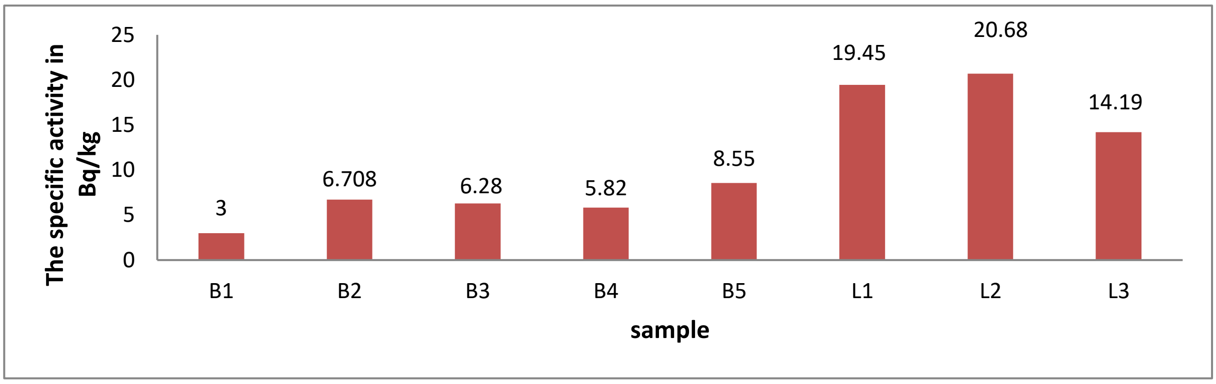

Fig. 4. Specific activity of ^{40} k for different types of legumes from Iraq markets

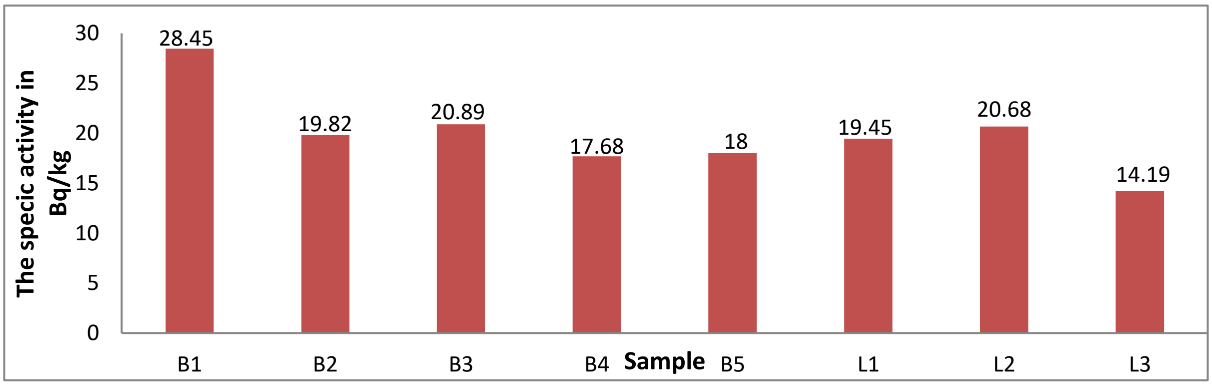

Fig. 5. Specific activity of ^{238}Ufor different types of legumes from Iraq markets

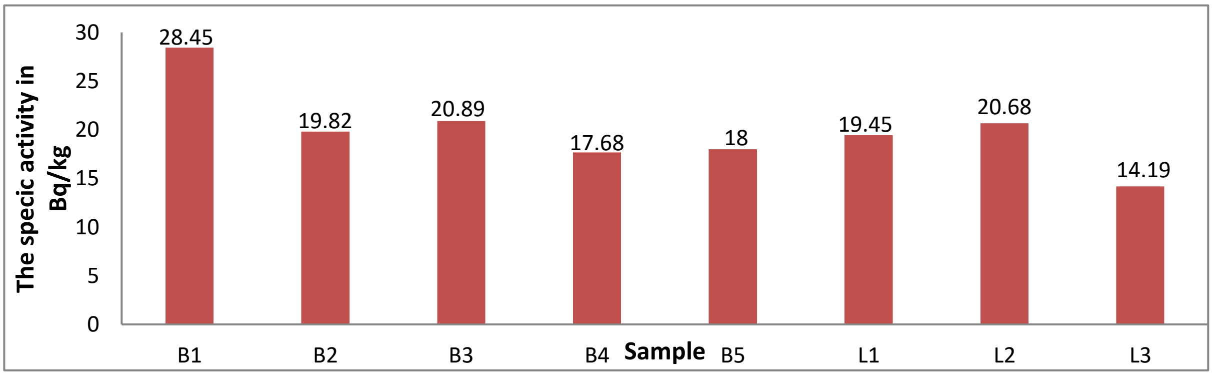

Fig. 6. Specific activity of ^{238}Ufor different types of legumes from Iraq markets

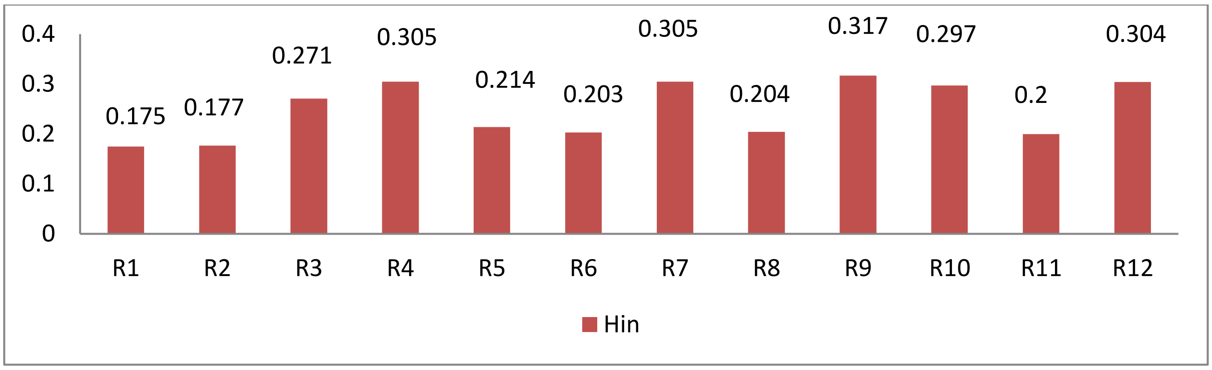

Fig. 7. The internal hazard index of different rice types from Iraq markets

Fig. 8. The internal hazard index of different legumes types from Iraq markets

Conclusion

The calculation shows the specific actvitity y ^{40} k is higher then the specific activityof ^{238}U, ^{232}Th, all the values specific activity was in the range of allowed levels according to UNSCEAR.

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