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Determination of natural radiation contamination for some types of legumes available in the Iraqi markets

Ali A. Al-Hamidawi, Hussain H. Al-Gazaly and Lubna A. Al-Alasadi

University of Kufa, Faculty of Science, Department of Physics, Iraq

ABSTRACT

In this research, the Uranium (U-238), Thorium (Th-232) and Potassium (K-40) with the specific activity (10) in some types of legumes that are available in the Iraqi market samples had been measured and the internal hazard index, radium equivalent and the annual effective dose of K-40 in all samples were determined. The gamma spectrometry method with a NaI(Tl) detector was used for radiometric measurements. It was found that the specific activity in legumes varied from 1.450±0.096 to 12.307±0.387 Bq/kg (average of 7.475 Bq/kg) for U-238, from 0.371±0.058 to 9.289±0.465 Bq/kg (average of 3.79941 Bq/kg) for Th-232, and from 64.096±1.037 to 603.397±8.757 Bq/kg (average 385.2477 Bq/kg) for K-40. The results were compared with international recommended values and were found to be within the international level.

Keywords: Natural radioactivity, Iraq markets, Legumes

INTRODUCTION

The continues increase in using radioactive sources in different activities in our daily lives may be increase the opportunity of radioactive pollution and also the exposed radiation[1,2]. So, the need to know the ways of estimate the radioactive elements and measured the radioactivity in foods samples and drinking water were increase [3]. There are many Global and local studies interested in recognition of radioactive pollution in exported and imported food and point to appearance of match potassium K^{40} in all food samples ,and the consumption in exported and imported food through these years did not cause any radiation dose over the Global recommended limit [4-6].

The legumes plant are the oldest plant known to the human , the traces in Mexico caves refer to cultivation of kidney beans were before the cultivation of maize a thousand years. Legumes take a mainly role in human and animal foods , when talk about the important food it became after the grain and represent an important source for protein and calcium, in countries (less in growth) legumes are the mainly food[7,8]. The most famous legumes are beans, kidney, lentils, livestock and burgle as which is recently widely cultivated in Europe and America. Legumes have many properties most important are : roots are very deep and it rich the soil with Ozon, and could easily absorbed the food elements and in this way it serve the soil by made it better, also the dense cultivation prevent weed, it placed between two types of grains in the cultivation circle and cultivation after fertilized potatoes[9].

This work was undertaken with the purpose of measuring natural radioactivity due to ^{238}U, ^{232}Th and ^{40}K some sample of legumes that available in the Iraqi markets and the determination of their annual effective dose for K-40 element to human over 17 years old , radium equivalent and internal hazard of gamma concentration index, so as to compare them with the recommended limits

MATERIALS AND METHODS

In this study samples collected from the locally Iraqi markets, and contain ten types of legumes as shown in Table (1) which are : lentil, bulgur, livestock, chickpeas and beans. The weight of each samples 600 gm after smashing and converted to soften powder and put into a plastic one liter marinelli beaker to decrease the distance between atoms.

Table .1. Types and made of legumes samples in this study

Samples	Name of samples	Made of samples
S1	Lentils	Turkey
S2	Groats	Turkey
S3	Hiker	Iraq
S4	Bake	Mexican
S5	Bake	Turkey
S6	Kidney bean	U.S.A
S7	Bean	Egypt
S8	string bean	Argentina
S9	Hiker	Uzbekistan
S10	string bean	Egypt

The natural radioactivity were measured for each sample by using Gama spectroscopy which is contain of detector NaI (Tl) the volume of crystal is (“3 * 3”) and multichannel analyst (4096 channel) and desperation energy (FWHM) in the peak 1.33KeV for Co^{60} is 6.05% . The radioactive background decrease for different radiations by using shield which is consist of two layers , first one of stainless steel with width (10 mm) and the second layer lead (30 mm). The detector calibrated by using standard radioactive sources, the energy of these sources are closed to the energy of the samples in order to calculate the detector efficiency. The standard source put over the detector with a geometric match exactly to the geometrical sample form and with same distance between the sample and the detector. It was found that the efficiency decrease when the energy of the radioactive source increase, and the same thing when the volume of sample increase on (600ml). To decreased the scattering radiation from the interaction of the radiation in the sample with shield. the sample put in the middle of room shield with period about (5 hours) according to radioactivity for each of K-40 , U-238 and Th-232 using (EC & NORTEC) program. The natural radioactivity for the light peaks determined for K-40 at energy (1460 KeV) ,U-238 from the daughter (Bi-214) at energy of (1764.49 KeV) and Th-232 from the daughter (Ti-208) at energy (2614 KeV).

Activity Concentration

Since the counting rate is proportional to the amount of the radioactivity in a sample, the Activity Concentration (*Ac*) which can be determined a specific activity as the follows [10]:

$$Ac = \frac{C-BG}{\varepsilon\%\ M\ I_\gamma} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where Ac is the specific activity, C is the area under the photo peaks, ε% : Percentage of energy efficiency. I_γ is the percentage of gamma-emission probability of the radionuclide under consideration , t is counting time , M is mass of sample and BG is background .

Radium Equivalent Activity

Radium equivalent activity (*Raeq*) is used to assess the hazards associated with materials that contain ^{226}Ra, ^{232}Th and ^{40}K in Bq/kg [11], which is, determined by assuming that 370 Bq/kg of ^{226}Ra or ^{260} Bq/kg of ^{232}Th or 4810 Bq/kg of ^{40}K produce the same γ dose rate [12-14]. The Ra_{eq} of a sample in (Bq/kg) can be achieved using the following relation [12,15]:

$$Ra_{eq} = A_U + (1.43 \times A_{Th}) + (A_k \times 0.077) \quad \ldots\ldots\ldots(2)$$

The published maximal admissible (permissible) Raeq is 370 Bq/kg [11].

Internal Hazard Index

The internal hazard index should be less than unity for the radiation hazard to be considered negligible. Inhalation of alpha particles emitted from the short-lived radionuclides radon (^{222}Rn, the daughter product of ^{226}Ra) and thoron (^{220}Rn, the daughter product of ^{224}Ra) are also hazardous to the respiratory tract.

This hazard can be quantified by the internal hazard index (H_{in}) [13,16,17]. This is given by the following equation:

$$H_{in} = (A_U/185) + (A_{Th}/259) + (A_K/4810) \quad \ldots\ldots\ldots\ldots(3)$$

The internal hazard index should also be less than unity to provide safe levels of radon and its short-lived daughters for the respiratory organs of individuals living in the dwellings.

Annual effective dose

In this study , annual effective dose were calculated for eating K-40 in foods through equation follow[18]:

$$D\left(\frac{Sv}{y}\right) = C\left(\frac{Bq}{Kg}\right) xM \left(\frac{Kg}{y}\right) xCf\left(\frac{Sv}{Bq}\right) \quad \ldots\ldots\ldots(4)$$

Where
D is the annual effective dose in (Sv/y), **C** is the specific activity in (Bq/Kg), **M** is the mass of eating in year (Kg/y) and **Cf** is converted factor of K-40 in (Sv/Bq) for the persons who live over 17 year equal (6.2x10-9 Sv/Bq).

RESULTS AND DISCUSSION

Table 2 summarize the measured concentrations of the naturally occurring radioactive elements ^{238}U, ^{232}Th and ^{40}K in different types of legumes that available in Iraq markets, while Table 3 show radiological hazard indices in some types of Legumes. The percentage distributions of ^{238}U, ^{232}Th and ^{40}K in different legumes samples are shown in Fig. (2, 3, and 4) respectively, but Fig.(5, 6 and 7) are shown radium equivalent, internal hazard index and annul effective dose of ^{40}K respectively. The results indicated that the main contribution to the background Gamma-radiation in legumes is the radiation from the natural radioactive series notably ^{40}K, ^{238}U and ^{232}Th. The ^{238}U content of all samples ranged from 1.450±0.096 to12.307±0.387 Bq/kg while ^{232}Th content ranged from 0.371±0.058 to 9.289±0.465 Bq/kg and ^{40}K content ranged from 64.096±1.037 to 603.397±8.757 Bq/kg. The highest activity concentration for ^{238}U and ^{232}Th is observed in Hiker (made in Iraq) and Kidney bean (made in USA) samples respectively, which are much lower than recommended limit(45 and 32 Bq/kg) for ^{238}U and ^{232}Th, respectively, reported by UNSCEAR (2008), while the highest activity concentration for ^{40}K for samples S3, S6, S7, S8 and S10 samples which are much higher than the world wide average (412 Bq/kg) reported by UNSCEAR (2008) [19]. The reason for vibration in natural radioactivity could be a function of geological structure of the area which it is grow the legumes of samples, but the reason of increasing a specific activity of ^{40}K over the world wide average may be due to Plant Fertilizers that rich phosphate used to grow the legumes. Ra-equivalent activities of legumes samples can be calculated from the Eq. (2), the results obtain varied (20.737085 - 55.711035) Bq/kg with average (42.57) Bq.Kg^{-1},which are below the recommended value 370 Bq/kg [13]. The internal hazard index(H_{in}) can be calculated from the Eq. (3). H_{in} results in legumes samples range from (0.08487- 0.173646) Bq.kg^{-1} with average 0.135168 Bq.kg^{-1}, therefore average value is less than unity [19]. The annual effective dose of ^{40}K calculated using Eq.(4) has the highest value at sample (S8) of (0.52 mSv.y^{-1}) which still it is less than those reported of (1 mSv.y^{-1}) [19]. Comparing these results a specific activity of ^{40}K with those of some countries, the range of average in Iraq is (255) Bq/kg [20] and in Malaysia the average was reported to be about (0.1-2552.3) Bq/kg [21].

Table . 2. A specific activity of ^{238}U, ^{232}Th and ^{40}KNatural radioactivity in some types of legumes

Samples	Specific activity in (Bq/kg)		
	K^{40}	U^{238}	Th^{232}
S1	333.996±7.578	11.1850±0.690	0.371±0.058
S2	64.096±1.037	10.675±0.341	3.5851±0.137
S3	469.476±1.339	12.307±0.387	2.536±0.068
S4	334.871±6.221	8.954±0.287	2.384±0.081
S5	256.190±8.124	8.607±0.241	8.728±0.273
S6	433.195±9.478	1.450±0.096	9.289±0.465
S7	442.219±8.834	4.959±0.141	3.567±0.022
S8	603.397±8.757	5.607±0.215	2.462±0.042
S9	356.942±6.458	2.421±0.142	2.168±0.023
S10	558.095±9.228	8.585±0.141	2.904±0.017

Table . 3. Radiological hazard indices in some types of Legumes

Samples	Ra equivalent (Bq kg^{-1})	Internal hazard index	Annual Effective Dose rate (mSv.y^{-1})
S1	37.433222	0.13133	0.289908528
S2	20.737085	0.08487	0.055635328
S3	52.083132	0.17392	0.407505168
S4	38.148187	0.127224	0.290668028
S5	40.81467	0.133485	0.22237292
S6	48.089285	0.133764	0.37601326
S7	44.110673	0.132515	0.383846092
S8	55.589229	0.16526	0.523748596
S9	33.005774	0.095665	0.309825656
S10	55.711035	0.173646	0.48442646

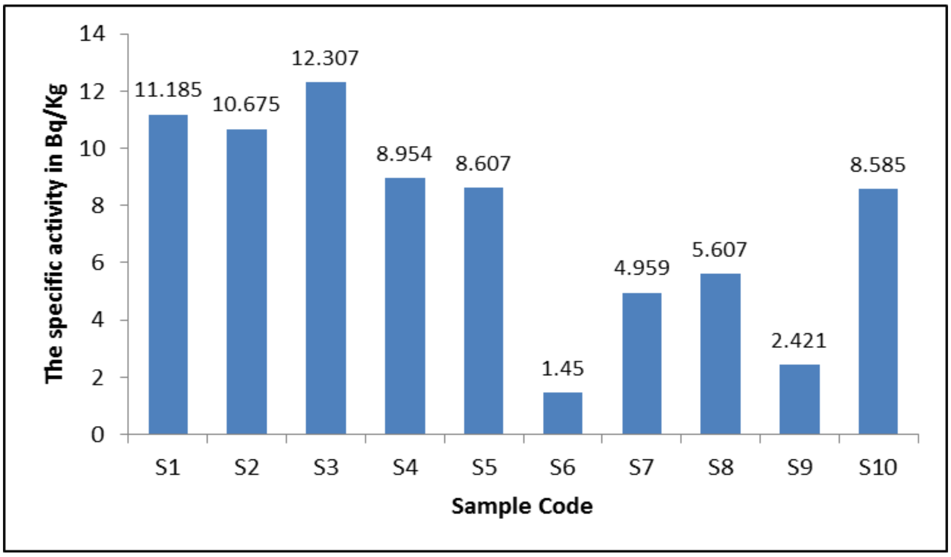

Fig. 2. Average activity of ^{238}Uof different legumes types from Iraq markets

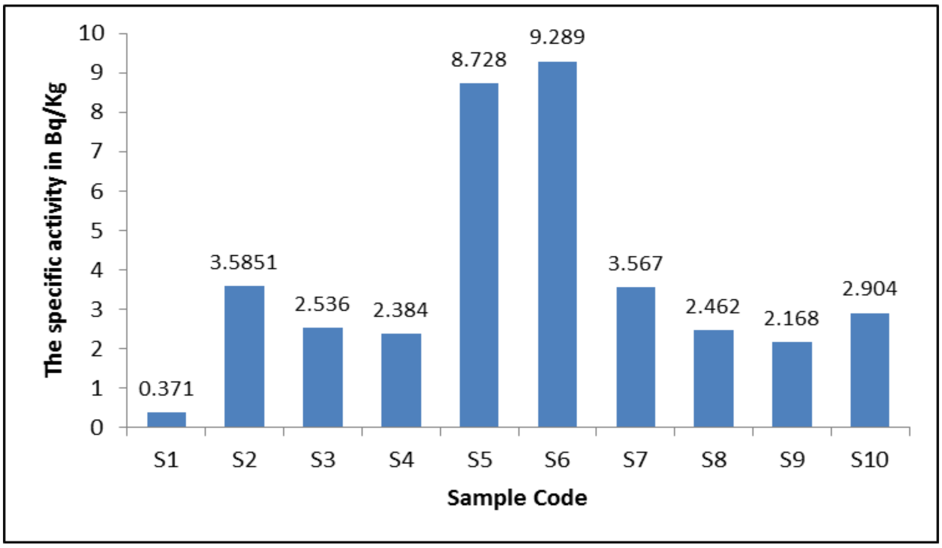

Fig. 3. Average activity of ^{232}Th of different legumes types from Iraq markets

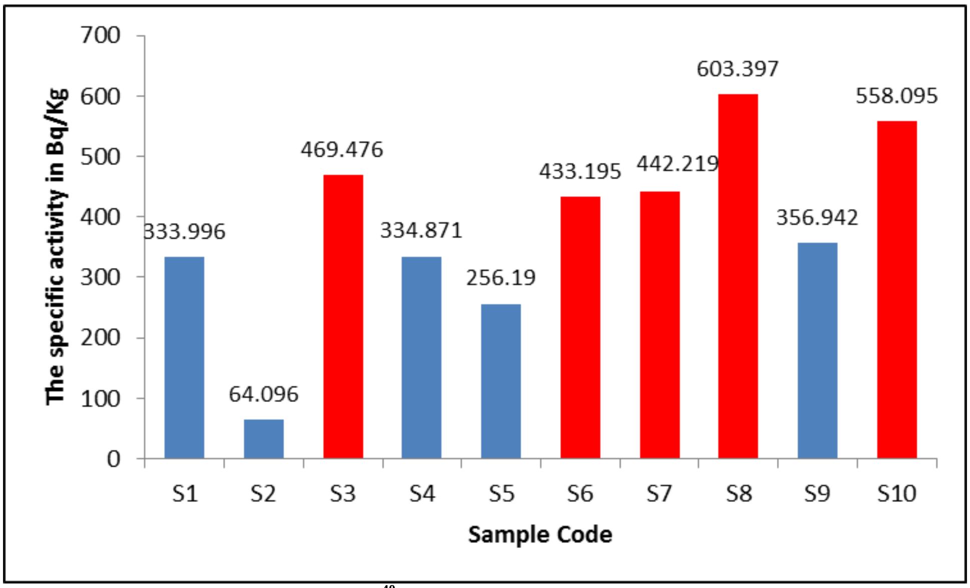

Fig. 4. Average activity of ^{40}K of different legumes types from Iraq markets

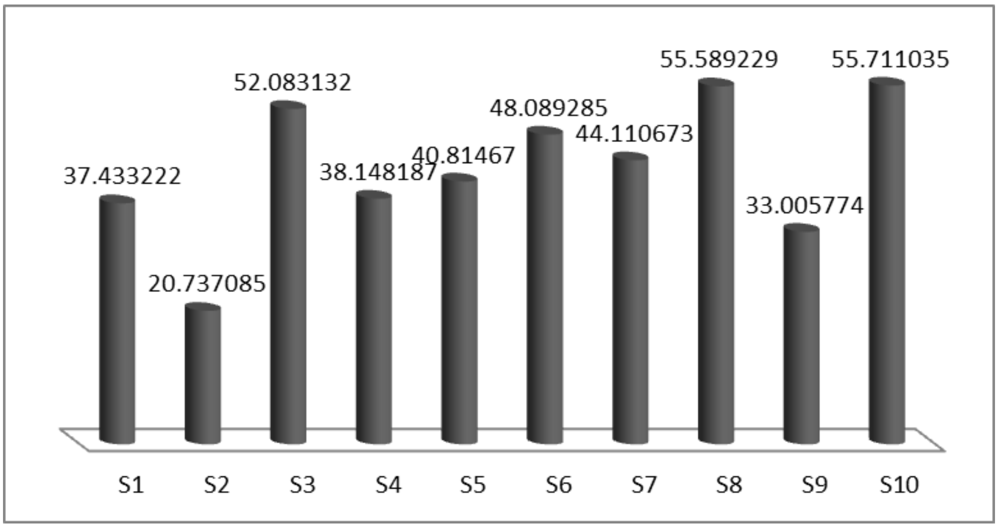

Fig. 5. Ra-equivalent activities of different legumes types from Iraq markets

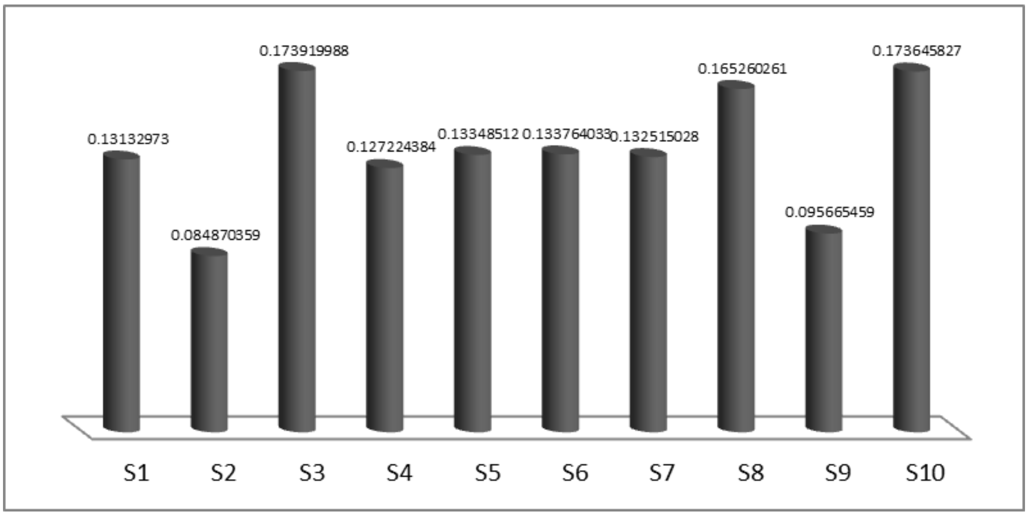

Fig. 6. The internal hazard index of different legumes types from Iraq markets

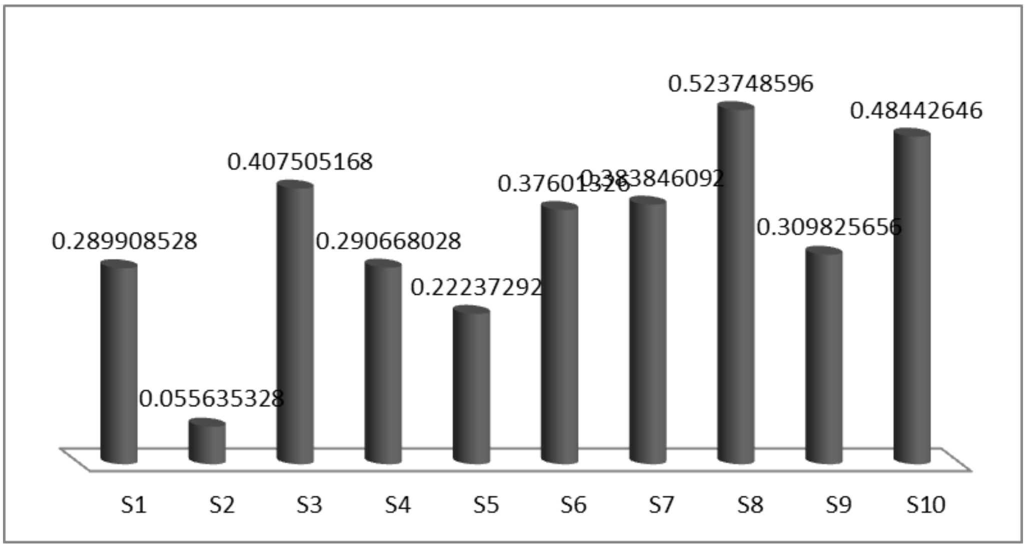

Fig. 7. The annual effective dose of ^{40}K of different legumes types from Iraq markets

CONCLUSION

The present study is the important at the national level to investigate radioactivity of legumes that available in Iraqi markets. It is found that the (S3, S6, S7, S8 and S10) have higher specific activity for ^{40}K compared with safe limit values recommended by UNSCEAR (2008) while the radium equivalent activities, internal hazard indices and the annual effective dose of ^{40}K are lower than international recommended values. The findings of this work will help in establishing a baseline of radioactivity exposure to the general public from ingestion of foodstuff.

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REFERENCES

[1] Sharama N., SharamaR. and Virk H.S., *Advanced in Applied Science Research*, **2011**, 2(3), pp 186-190
[2] Viruthagiri G. and Ponnarasi, *Advanced in Applied Science Research*, **2011**, 2(2), pp 103-106
[3] United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and effects of ionizing radiation. New York: United Nations, **2012**.
[4] Iraqi Atomic Energy Organization Baghdad, "Radioactivity in food of imported and locally ", **2000**.
[5] Walid M. S. and Iftikhar H., Radiation protection center of Iraq, **2001**.
[6] Bhshry A. , Moni T., and Iftikhar H, Radiation protection center of Iraq, **2005**.
[7] Purseglove J. W., "Tropical Crops-Dicotyledons", ELBS Series, London: Longman, Group Ltd, 1974,
[8] Bhosale U. P. and. Hallale B. V, *Asian Journal of Plant Science and Research*, **2011**, 1 (2):96-100.
[9] Kurlovich B.S. and Repyev S.I. , " Vavilov Institute of Plant Industry",**1995**, pp.438.
[10] Jose A., Jorge J., Cleomacio M., Sueldo M. and Romilton S.. *Brazilian Archives of Biology and Technology*, **2005**.48, pp. 221-228.
[11] UNSCEAR, Effects of Atomic Radiation to the General Assembly, in United Nations Scientific Committee on the Effect of Atomic Radiation., United Nations: New York, **2000**.
[12] UNSCEAR, Ionising Radiation: Sources, and Biological Effect United Nations Scientific Committee on the Effect of Atomic Radiation., United Nations: New York, **1982**.
[13] Beretka J. and Mathew P., *Health Phys*., **1985**, 48,pp. 87-95.
[14] Kumar A., Singh B. and Singh S., *Radiation Measurements*, **2003**, 36(1-6),pp 465-469.
[15] Viruthagiri G. and Ponnarasi K., *Advances in Applied Science Research*, **2011**, 2 (2): 103-108.
[16] Lu. Xinwei, China. *Radiation Measurements*, **2005**, 40(1), pp. 94-97.
[17] Adamu R., Zakari Y. I., Ahmed A. Y., Abubakar. S. and Vatsa A. M., *Advances in Applied Science Research*, **2013**, 4(4):283-287.
[18] safety series No. 115, IAEA , Vienna , **1996**.
[19] UNSCEAR, Report to General Assembly. Annex B: Report to General Assembly with Scientific Annexes. Sources and Effects of Ionizing Radiation. United Nations Sales Publications No. E.10.Xi.3 Volume I. United Nations, New York, **2008**.
[20] Mohammad Y., "Radioactivity in some Local food and Imported food" , 5th Scientific Conference of College of Agriculture -Tikrit University From 26 to 27 April **2011**.
[21] Laili Z., *Bibliographic Citation* , **2006**, P.136-143.