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Measurement of Specific Activities of Some Biological Samples for Some Iraq Governorates

Mahmood S. Karim
Department of Physics, College of Education, Al-Mustansiriyah University-Iraq
Email: mahmood_msc74@yahoo.co.uk

***Abstract*- The specific activities of radionuclides in five human tissues samples (Kidney, breast, colon, lung and uterus) that excised from patients living in (Baghdad, Wasit, Thi-Qar, Missan and Basrah) governorates by using NaI(Tl) detector. The results of measurements have shown that, in Basrah governorate the tissues samples (Kidney, breast, colon and uterus) were found to having the highest specific activity of (^{238}U) which was equal to (4.32 Bq/kg), (8.32 Bq/kg), (6.65 Bq/kg) and (5.43 Bq/kg), respectively, while in Baghdad governorate having the highest specific activity of (^{238}U) in lung tissue sample which was equal to (16.32 Bq/kg). In Basrah governorate the tissues samples (breast and colon) were found to having the highest specific activity of (^{232}Th) which was equal to (8.01 Bq/kg) and (7.37 Bq/kg), respectively, while in Wasit governorate the tissues samples (Kidney and Lung) were found to having the highest specific activity of (^{232}Th) which was equal to (5.40 Bq/kg) and (8.87 Bq/kg), respectively, finally, in Thi-Qar governorate the uterus tissue sample were found to having the highest specific activity of (^{232}Th) which was equal to (4.53 Bq/kg). In Basrah governorate the tissues samples (Kidney, breast, colon, uterus) were found to having the highest specific activity of (^{40}K) which was equal to (9.87 Bq/kg), (15.05 Bq/kg), (14.20 Bq/kg) and (7.66 Bq/kg), respectively, while in Wasit governorate having the highest specific activity of (^{40}K) in Lung tissue sample which was equal to (14.44 Bq/kg).**

***Keywords* - Specific activities, NaI(Tl) detector, tissues samples.**

I. INTRODUCTION

The human contains several radionuclides inside their bodies coming either from continuing exposed to the natural (terrestrial, cosmic and radon) and artificial radiation sources, or they are inside their bodies from birth, such as lead-210 potassium-40, and carbon-14 [1].

The solubility of radioactive particles determines the rate that particles move from the site of internalization (gastro-intestinal tract for ingestion pathway, lung for inhalation pathway) into the blood stream and can be stored in the lung, kidney, lymph, womb, bone, or other tissues [2].

The body has defense mechanisms against many types of damage induced by radiation. An isotope which is tightly bound inside the body will essentially decay with physical half-life (time for the radioactivity to decay to half its original value), while a long-lived isotope excreted quickly will be removed with a biological half-life (time required for an organ, tissue or the whole body to eliminate one-half of an administered quantity of any substance by regular process of elimination) [3].

II. EXPERIMENTAL PART

Using of gamma-ray spectroscopy technique is based on the high penetrating power of gamma rays in the materials. Gamma-ray spectrometer system consists of a scintillation detector Sodium Iodide activated by Thallium NaI(Tl) of (3"×3") crystal dimension, supplied by (Alpha Spectra, Inc.-12I12/3), coupled with a multi-channel analyzer (MCA) (ORTEC-Digit Base) with range of (4096) channel joined with analog to digital converter (ADC) unit, through interface. The spectroscopic measurements and analysis are performed via the (MAESTRO-32) software into the PC of the laboratory. The conversion of radiation energy into electrical pulse is the principle of operating for all detectors. Sodium Iodide activated by Thallium is most widely used as scintillator. Its key feature includes high light yield, very low self-absorption of scintillation light, good spectroscopic performance,

easy availability, low production cost and possibility of producing large crystals. When a gamma-ray enters the crystal, it will suffer some processes. The most important interaction mechanisms are the photoelectric, Compton effect and pair production. The electrons (or positrons) produced by these interactions deposit their energy in the counter and thus generate a voltage pulse that signifies the passage of the photon [4]. In order to reduce the background radiation, the detector is maintained in a vertical position and shielded by the ORTEC cylindrical chamber. As shown in figure (1-a). The shielding consists of two parts, the upper one is composed of lead (5cm) thick and (20cm) long surrounding the crystal with a cover that is (5cm) thick and has a diameter of (22cm), which is the lower part forms the base. The photograph of the shielding is shown in figure (1-b).

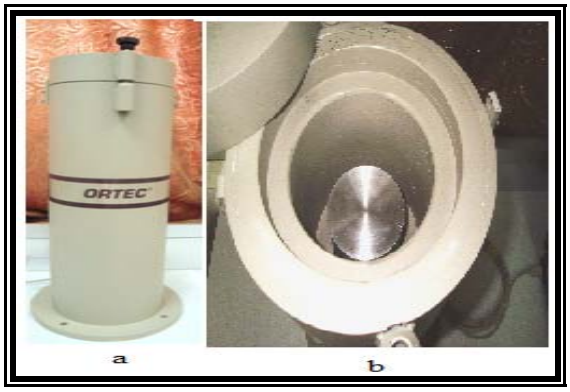

Figure (1): a-Block diagram of a spectrometer system
b- Detector position in the shielding.

The efficiency ε of the detector measuring system for particular energy is calculated using the following relation [4]:

$$\varepsilon(E_\gamma) = \frac{N}{A \cdot I_\gamma(E_\gamma) \cdot t} \times 100\% \qquad \ldots (1)$$

Where N is the count of gamma rays (area under the specified energy peak after background subtraction), $I_{\square}$ is the transition probability of the emitted gamma ray and t is the time in (sec) for spectrum collected (we using high measurement time in order to high efficiency of the detector) [4].

Each tissues samples under investigation was about of (300 g) in weight ,which was washed with distilled water to remove the formalin liquid, and was cut and burned by using the oven and put in the marenilli beaker uniformly and then examined with NaI(Tl) detector for a period of (8) hours. Gamma ray spectroscopy system was employed using NaI(Tl) detector with (40%) efficiency and (2.2 keV) resolution power at the energy of (1332keV) from a ^{60}Co source. This system was calibrated by using ^{152}Eu source with the same geometry of marenilli pot and experimental conditions after shielding the detector with a lead shield to reduce the radioactive background, which was calculated to be extracted from the typical mean value of the studied sample, then the specific activity for each detected radionuclide (radioactive element) had been calculated using the following equation [5]:

$$\text{Specific Activity} = \frac{\textit{Net area under the peak}}{W \times I_\gamma \times \textit{Eff.} \times T} \qquad \ldots\ldots (2)$$

Where,

T = Measuring time (s)

Eff. = Percentage efficiency

I_γ = Percentage intensity of gamma-ray

W= Mass of the sample (kg)

The typical radioactivity of ^{214}Bi, ^{214}Pb and ^{210}Po isotopes was considered at energies of (4700 keV), (609 keV) and (352 keV), respectively, as equivalent to that of ^{238}U by choosing the higher value. Similarly, the typical radioactivity of ^{228}Ac and ^{208}Tl isotopes was considered at energies of (583 keV) and (911 keV), respectively, as equivalent to that of ^{232}Th by choosing the higher value. Additionally, the typical radioactivity of ^{40}K isotope was calculated at energies of (1460.8 keV), empty marinelli beaker is used for counting in the same time under identical geometry to determine the background spectrum.

In the present work, all tissues samples (Kidney, breast, colon, lung and uterus) had been collected from the histopathology department in educational laboratories belong in each governorate, and any other information about these samples had also been collected such as gender and age.

III. RESULTS AND DISCUSSION

The results of the present work are summarized in tables (I to V) it can be concluded that:

1) From Kidney tissues samples, the highest value of specific activity of (^{238}U) was found in Basrah governorate which was equal to (4.32 Bq/kg), from male age 55 years, and the highest value of specific activity of (^{232}Th) was found in Wasit governorate which was equal to (5.40 Bq/kg), from female age 37 years, and the highest value of specific activity of (^{40}K) was found also in Basrah governorate which was equal to (9.87 Bq/kg), from male age 55 years, while the lowest value of specific activity of (^{238}U) was found in Baghdad governorate which was equal to (1.45 Bq/kg), from female age 50 years, and the lowest value of specific activity of (^{232}Th) was found in Thi-Qar governorate which was equal to (4.24 Bq/kg), from female age 48 years, and the lowest value of specific activity of (^{40}K) was found in Missan governorate which was equal to (6.06 Bq/kg), from male age 37 years, these results indicate that high concentration of the uranium in the kidney samples, because approximately 70% of the uranium that is absorbed into the blood will be filtrated by this organ [6].
2) From breast tissues samples, the highest value of specific activity of (^{238}U) was found in Basrah governorate which was equal to (8.32 Bq/kg), from female age 39 years, and the highest value of specific activity of (^{232}Th) was found also in Basrah governorate which was equal to (8.01 Bq/kg), from female age 47 years, and the highest value of specific activity of (^{40}K) was found also in Basrah governorate which was equal to (15.05 Bq/kg), from female age 39 years, while the lowest value of specific activity of (^{238}U) was found in Missan governorate which was equal to (4.50 Bq/kg), from female age 52 years, and the lowest value of specific activity of (^{232}Th) was found in Wasit governorate which was equal to (5.32 Bq/kg), from female age 45 years, and the lowest value of specific activity of (^{40}K) was found in Thi-Qar governorate which was equal to (6.76 Bq/kg), from female age 66 years, we can conclude that breast tissue is highly susceptible to the radionuclides because it contains much lymphatic vessels and Lymphocytes [7].
3) From colon tissues samples, the highest value of specific activity of (^{238}U) was found in Basrah governorate which was equal to (6.65 Bq/kg), from female age 36 years, and the highest value of specific activity of (^{232}Th) was found also in Basrah governorate which was equal to (7.37 Bq/kg), from female age 60 years, and the highest value of specific activity of (^{40}K) was found also in Basrah governorate which was equal to (14.20 Bq/kg), from female age 69 years, while the lowest value of specific activity of (^{238}U) was found in Wasit governorate which was equal to (4.03 Bq/kg), from female age 59 years, and the lowest value of specific activity of (^{232}Th) was found in Baghdad governorate which was equal to (4.16 Bq/kg), from female age 65 years, and the lowest value of specific activity of (^{40}K) was found in Missan governorate which was equal to (10.06 Bq/kg), from male age 69 years, we can conclude that diverse radionuclides appeared in the colon tissue because this organ is directly exposed to all the radionuclides that may be reach it by ingestion (water , food, etc.) which differ from person to another.
4) From lung tissues samples, the highest value of specific activity of (^{238}U) was found in Baghdad governorate which was equal to (16.32 Bq/kg), from male age 56 years, and the highest value of specific activity of (^{232}Th) was found also in Wasit governorate which was equal to (8.87 Bq/kg), from female age 55 years, and the highest value of specific activity of (^{40}K) was found also in Wasit governorate which was equal to (14.44 Bq/kg), from male age 47 years, while the lowest value of specific activity of (^{238}U) was found in Missan governorate which was equal to (9.13 Bq/kg), from male age 58 years, and the lowest value of specific activity of (^{232}Th) was found in also Missan governorate which was equal to (6.54 Bq/kg), also from male age 58 years, and the lowest value of specific activity of (^{40}K) was found in Thi-Qar governorate which was equal to (11.23 Bq/kg), from male age 54 years.
5) From uterus tissues samples, the highest value of specific activity of (^{238}U) was found in Basrah

governorate which was equal to (5.43 Bq/kg), from female age 48 years, and the highest value of specific activity of (^{232}Th) was found also in Thi-Qar governorate which was equal to (4.53 Bq/kg), from female age 67 years, and the highest value of specific activity of (^{40}K) was found also in Basrah governorate which was equal to (7.66 Bq/kg), from female age 48 years, while the lowest value of specific activity of (^{238}U) was found in Missan governorate which was equal to (2.14 Bq/kg), from female age 52 years, and the lowest value of specific activity of (^{232}Th) was found in Missan governorate which was equal to (3.05 Bq/kg), from female age 59 years, and the lowest value of specific activity of (^{40}K) was found in Baghdad governorate which was equal to (5.32 Bq/kg), from female age 61 years, we can conclude that uterus tissue contained few radionuclides compared with other tissues because this organ consists of reborn cells (that is, they have short age), so it removes the radionuclides by decaying the cells, in addition to the biological elimination process [8]. The present research is considered one of the important studies because they relate to the lives of people in central and southern Iraq and it is the first study to include the measurement of radioactivity to five different samples and five Iraqi governorates.

IV. CONCLUSIONS

1) Basrah governorate having the highest specific activity of (^{238}U) and (^{40}K) from (Kidney, breast, colon, uterus) tissues samples and having the highest specific activity of (^{232}Th) from (breast and colon) tissues samples, while in Wasit governorate having the highest specific activity of (^{232}Th) from (Kidney and Lung) tissues samples and having the highest specific activity of (^{40}K) from Lung tissue sample, while in Thi-Qar governorate having the highest specific activity of (^{232}Th) from uterus tissue sample, while in Baghdad governorate having the highest specific activity of (^{238}U) from Lung tissue sample.
2) Uterus tissue contained few radionuclides compared with other tissues, while Lung tissue contained more radionuclides compared with other tissues.
3) Some types of radioactive elements were found to appear in some samples while they were found to be absent in others.

V. ACKNOWLEDGEMENTS

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Table I

Radioactive elements (radionuclides) and specific activities for selected samples tissues in Baghdad governorate

Sample				Specific activity (Bq/kg)					
				U-238			Th-232		K-40
Tissues samples	No.	Sex	Age	Bi-214	Pb-214	Po-210	Ac-228	Tl-208	
Kidney	1	male	55	0.12	0.17	B.D.L	1.32	0.68	3.37
	2	male	60	0.13	B.D.L	B.D.L	0.89	2.53	3.90
	3	male	56	B.D.L	0.04	B.D.L	B.D.L	3.76	5.11
	4	female	49	0.18	1.21	0.32	2.21	B.D.L	5.31
	5	female	58	B.D.L	1.02	B.D.L	B.D.L	4.67	8.43
	6	female	50	B.D.L	1.45	B.D.L	0.32	B.D.L	7.78
Breast	1	female	53	B.D.L	4.79	3.24	3.36	2.46	4.91
	2	female	39	2.03	B.D.L	3.21	4.65	4.29	9.18
	3	female	48	3.01	4.53	B.D.L	B.D.L	4.17	B.D.L
	4	female	37	B.D.L	2.21	6.57	5.58	B.D.L	B.D.L
	5	female	60	5.32	B.D.L	2.62	B.D.L	3.09	B.D.L
	6	female	57	B.D.L	1.23	1.35	6.65	5.48	4.38
Colon	1	male	65	1.22	B.D.L	2.21	1.01	B.D.L	8.12
	2	male	58	1.42	3.01	B.D.L	2.12	3.73	4.65
	3	male	39	B.D.L	2.65	4.02	B.D.L	3.31	10.78
	4	female	65	2.11	B.D.L	4.84	B.D.L	4.16	7.81
	5	female	60	B.D.L	3.23	4.11	B.D.L	5.86	B.D.L
	6	female	51	2.57	2.42	B.D.L	1.61	1.35	2.98
Lung	1	male	56	7.25	B.D.L	16.32	B.D.L	5.73	12.82
	2	male	70	12.62	4.32	11.16	4.45	2.61	9.85
	3	male	47	8.65	4.67	11.14	6.07	B.D.L	7.66
	4	male	57	8.87	B.D.L	9.87	2.98	5.89	7.12
	5	female	39	B.D.L	5.32	B.D.L	B.D.L	7.99	9.02
	6	female	60	3.54	2.25	B.D.L	6.32	5.64	9.38
Uterus	1	female	59	0.23	B.D.L	B.D.L	2.14	0.87	4.43
	2	female	71	1.21	B.D.L	B.D.L	B.D.L	0.65	2.35
	3	female	48	B.D.L	B.D.L	B.D.L	0.98	1.23	B.D.L
	4	female	58	B.D.L	2.43	B.D.L	B.D.L	B.D.L	B.D.L
	5	female	61	2.01	1.06	B.D.L	B.D.L	B.D.L	5.32
	6	female	64	B.D.L	B.D.L	B.D.L	1.12	2.18	B.D.L

B.D.L= Below Detection Limit

Table II

Radioactive elements (radionuclides) and specific activities for selected samples tissues in Wasit governorate

Sample				Specific activity (Bq/kg)					
				U-238			Th-232		K-40
Tissues samples	No.	Sex	Age	Bi-214	Pb-214	Po-210	Ac-228	Tl-208	
Kidney	1	male	62	0.32	1.22	B.D.L	2.02	B.D.L	7.65
	2	male	61	B.D.L	B.D.L	1.11	0.89	3.53	4.54
	3	male	46	1.12	B.D.L	2.04	B.D.L	4.76	B.D.L
	4	male	71	0.98	B.D.L	B.D.L	B.D.L	3.05	B.D.L
	5	female	50	B.D.L	3.02	0.92	B.D.L	4.67	6.68
	6	female	37	2.1	1.87	B.D.L	1.32	5.40	7.21
Breast	1	female	62	3.70	B.D.L	6.04	4.56	B.D.L	2.74
	2	female	45	5.23	B.D.L	2.41	B.D.L	5.32	5.63
	3	female	57	B.D.L	3.31	B.D.L	B.D.L	2.97	B.D.L
	4	female	39	B.D.L	1.43	6.07	2.58	B.D.L	3.57
	5	female	39	3.32	4.32	3.42	B.D.L	4.46	B.D.L
	6	female	46	2.08	1.23	B.D.L	3.51	3.74	7.03
Colon	1	male	60	B.D.L	2.87	1.34	B.D.L	3.21	6.67
	2	male	59	1.42	3.21	3.47	5.18	B.D.L	7.09
	3	male	47	B.D.L	B.D.L	B.D.L	2.87	B.D.L	B.D.L
	4	male	39	2.78	B.D.L	B.D.L	B.D.L	6.57	11.23
	5	female	53	3.45	2. 33	2.98	4.26	3.98	6.95
	6	female	59	2.37	3.23	4.03	B.D.L	4.67	4.08
Lung	1	male	47	B.D.L	11.43	B.D.L	6.67	3.23	14.44
	2	male	39	8.54	B.D.L	10.13	B.D.L	B.D.L	4.98
	3	male	40	10.67	B.D.L	12.04	B.D.L	B.D.L	9.87
	4	female	55	4.83	7.65	6.84	5.43	8.87	11.14
	5	female	55	B.D.L	6.30	B.D.L	6.69	5.94	10.82
	6	female	63	4.64	3.45	7.98	1.98	3.98	11.30
Uterus	1	female	58	B.D.L	2.99	1.09	B.D.L	B.D.L	B.D.L
	2	female	63	B.D.L	B.D.L	0.96	B.D.L	1.05	B.D.L
	3	female	39	3.20	B.D.L	B.D.L	B.D.L	4.03	5.98
	4	female	62	B.D.L	B.D.L	B.D.L	2.07	2.98	4.87
	5	female	61	2.98	2.37	2.21	1.87	B.D.L	B.D.L
	6	female	50	B.D.L	B.D.L	B.D.L	2.11	1.38	B.D.L

Table III

Radioactive elements (radionuclides) and specific activities for selected samples tissues in Thi-Qar governorate

Sample				Specific activity (Bq/kg)					
				U-238			Th-232		K-40
Tissues samples	No.	Sex	Age	Bi-214	Pb-214	Po-210	Ac-228	Tl-208	
Kidney	1	male	66	1.66	B.D.L	3.44	B.D.L	1.87	B.D.L
	2	male	54	0.98	1.34	B.D.L	3.09	2.03	5.57
	3	male	49	1.87	B.D.L	3.04	B.D.L	3.15	B.D.L
	4	female	48	B.D.L	0.89	B.D.L	2.03	4.24	B.D.L
	5	female	47	B.D.L	2.82	1.94	2.26	3.07	7.76
	6	female	60	2.12	B.D.L	3.67	B.D.L	B.D.L	4.11
Breast	1	female	66	2.34	3.21	5.64	5.54	B.D.L	6.76
	2	female	54	4.03	B.D.L	B.D.L	2.11	4.72	B.D.L
	3	female	56	B.D.L	1.87	4.93	B.D.L	3.07	3.87
	4	female	43	3.67	B.D.L	B.D.L	3.68	3.22	B.D.L
	5	female	46	B.D.L	4.02	2.82	2.34	B.D.L	5.43
	6	female	46	B.D.L	2.03	1.22	B.D.L	B.D.L	B.D.L
Colon	1	male	66	3.22	B.D.L	3.44	B.D.L	2.34	B.D.L
	2	male	56	B.D.L	6.01	2.87	5.56	B.D.L	11.09
	3	male	60	B.D.L	3.45	2.67	B.D.L	4.67	6.67
	4	male	46	6.08	B.D.L	B.D.L	4.56	4.75	B.D.L
	5	female	59	2.75	4. 03	1.95	5.66	B.D.L	7.35
	6	female	58	1.77	B.D.L	1.93	3.23	2.34	B.D.L
Lung	1	male	65	B.D.L	10.67	11.23	4.66	4.45	B.D.L
	2	male	54	7.76	5.56	8.19	8.85	B.D.L	11.23
	3	male	54	10.65	5.87	6.79	B.D.L	3.87	9.43
	4	male	48	B.D.L	7.63	B.D.L	3.45	6.54	6.18
	5	female	59	2.15	B.D.L	B.D.L	1.23	B.D.L	B.D.L
	6	female	53	3.64	B.D.L	2.34	B.D.L	2.12	B.D.L
Uterus	1	female	69	1.12	1.26	1.79	B.D.L	3.26	6.74
	2	female	67	2.84	B.D.L	B.D.L	4.53	4.46	B.D.L
	3	female	54	4.04	4.34	3.56	B.D.L	2.34	3.36
	4	female	60	B.D.L	2.67	2.54	2.32	B.D.L	4.65
	5	female	39	1.43	B.D.L	B.D.L	1.21	1.34	B.D.L
	6	female	57	B.D.L	1.23	1.66	2.53	B.D.L	B.D.L

Table IV

Radioactive elements (radionuclides) and specific activities for selected samples tissues in Missan governora

Sample				Specific activity (Bq/kg)					
				U-238			Th-232		K-40
Tissues samples	No.	Sex	Age	Bi-214	Pb-214	Po-210	Ac-228	Tl-208	
Kidney	1	female	63	2.02	1.25	2.52	1.43	B.D.L	B.D.L
	2	female	51	2.03	3.04	B.D.L	B.D.L	2.43	4.07
	3	female	41	B.D.L	2.93	3.21	B.D.L	5.34	B.D.L
	4	male	38	B.D.L	B.D.L	3.22	1.67	B.D.L	B.D.L
	5	male	37	1.55	B.D.L	B.D.L	2.36	2.27	6.06
	6	male	55	1.87	3.21	2.65	B.D.L	3.56	3.96
Breast	1	female	66	B.D.L	3.03	B.D.L	B.D.L	2.34	B.D.L
	2	female	49	3.32	2.11	B.D.L	B.D.L	3.38	6.63
	3	female	47	1.22	B.D.L	3.22	3.76	B.D.L	5.87
	4	female	52	2.04	B.D.L	4.50	1.98	B.D.L	5.65
	5	female	41	B.D.L	3.35	4.02	B.D.L	3.76	B.D.L
	6	female	40	B.D.L	2.65	1.22	4.01	2.94	7.61
Colon	1	female	62	2.87	B.D.L	2.84	2.11	B.D.L	B.D.L
	2	female	53	2.42	4.01	B.D.L	B.D.L	3.32	B.D.L
	3	female	37	B.D.L	3.23	B.D.L	B.D.L	3.87	B.D.L
	4	male	49	3.08	B.D.L	2.21	2.14	5.07	7.23
	5	male	56	B.D.L	4.21	3.08	3.06	B.D.L	6.05
	6	male	69	B.D.L	2.83	4.67	3.54	B.D.L	10.06
Lung	1	male	57	7.32	5.93	8.43	B.D.L	B.D.L	B.D.L
	2	male	58	5.54	B.D.L	9.13	B.D.L	3.23	B.D.L
	3	male	58	8.67	3.67	7.54	6.54	5.43	11.87
	4	male	50	3.83	6.05	B.D.L	1.43	2.12	B.D.L
	5	female	38	B.D.L	3.18	B.D.L	5.69	B.D.L	9.02
	6	female	49	B.D.L	B.D.L	3.11	B.D.L	B.D.L	10.32
Uterus	1	female	60	B.D.L	1.93	2.02	B.D.L	B.D.L	6.44
	2	female	61	1.01	B.D.L	1.56	1.54	2.03	2.98
	3	female	59	1.80	B.D.L	B.D.L	1.84	3.05	5.38
	4	female	52	B.D.L	1.67	2.14	B.D.L	1.68	B.D.L
	5	female	60	B.D.L	1.07	B.D.L	B.D.L	B.D.L	B.D.L
	6	female	58	2.03	B.D.L	B.D.L	1.51	B.D.L	1.32

Table V

Radioactive elements (radionuclides) and specific activities for selected samples tissues in Basrah governorate

Sample				Specific activity (Bq/kg)					
				U-238			Th-232		K-40
Tissues samples	No.	Sex	Age	Bi-214	Pb-214	Po-210	Ac-228	Tl-208	
Kidney	1	female	62	3.08	B.D.L	3.52	5.03	B.D.L	9.33
	2	female	58	B.D.L	B.D.L	4.01	3.65	4.73	8.07
	3	female	55	B.D.L	3.92	B.D.L	4.12	B.D.L	B.D.L
	4	male	55	2.45	4.32	B.D.L	B.D.L	B.D.L	9.87
	5	male	39	3.05	3.98	B.D.L	3.66	3.57	14.9
	6	male	65	2.43	2.81	3.15	3.98	3.89	B.D.L
Breast	1	female	60	B.D.L	B.D.L	5.54	4.32	B.D.L	13.65
	2	female	55	5.33	B.D.L	B.D.L	2.23	B.D.L	B.D.L
	3	female	53	6.02	4.56	B.D.L	3.32	5.54	B.D.L
	4	female	39	3.85	8.32	3.98	6.08	7.98	15.05
	5	female	47	B.D.L	4.95	7.95	B.D.L	2.93	11.43
	6	female	47	B.D.L	6.55	2.94	8.01	5.90	8.01
Colon	1	female	69	4.07	B.D.L	6.03	3.01	B.D.L	14.20
	2	female	60	4.02	3.91	2.98	B.D.L	7.37	B.D.L
	3	female	36	B.D.L	4.25	6.65	7.54	6.84	B.D.L
	4	female	58	B.D.L	B.D.L	5.29	B.D.L	B.D.L	5.03
	5	male	57	5.43	B.D.L	B.D.L	B.D.L	6.22	11.45
	6	male	60	3.34	5.03	B.D.L	2.94	B.D.L	9.56
Lung	1	male	57	8.62	6.67	9.32	B.D.L	5.56	5.33
	2	male	58	6.04	B.D.L	12.10	3.87	8.83	14.2
	3	male	58	11.07	5.69	B.D.L	7.04	B.D.L	11.87
	4	female	50	B.D.L	B.D.L	3.45	8.49	5.72	B.D.L
	5	female	38	B.D.L	3.15	4.02	B.D.L	3.21	B.D.L
	6	female	49	6.98	2.89	B.D.L	3.63	B.D.L	4.02
Uterus	1	female	59	B.D.L	B.D.L	5.08	3.54	B.D.L	B.D.L
	2	female	48	3.32	3.98	B.D.L	3.76	2.34	7.66
	3	female	48	2.15	3.12	5.43	B.D.L	3.67	B.D.L
	4	female	60	B.D.L	1.67	B.D.L	4.22	2.05	3.44
	5	female	55	B.D.L	2.87	B.D.L	2.23	B.D.L	4.67
	6	female	59	3.83	B.D.L	2.43	1.51	2.56	6.72