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SHORT COMMUNICATION

Measurement the natural radioactivity of Chicken meat samples from Karbala governorate

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ABSTRACT

In this paper, the measurement of natural radioactivity in Chicken meat samples from different regions of Karbala governorate by using (Na(Tl)) detector. The results of measurements have shown that the specific activity and the determination of some other related parameters such as (Raeq, Hin, Iɣ, Iα DɣE, Eff dos and AGDE). In Fourteen four chicken meat samples by using NaI(Tl) detector. The results have shown that, the mean specific activity of (40K, 238U and 232Th) which were (14.272±14.2 Bq/kg, 2.255±0.45 Bq/kg and 1.3±0.26), respectively, were found to be less than the recommended values of specific activity given by (UNSCEAR, 2000).

***Keyword*:** Na(Tl) detector, Chicken meat samples, Karbala governorate

1. INTRODUCTION

The biological effects of radiation are terms in their effect on the living cells. These effects depend on the type of cell, the amount and type of radiation. Consequently, biological

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effects of radiation on living cells may result in three outcomes: (1) injured or damaged cells repair themselves, resulting in no residual damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes; or (3) cells incorrectly repair themselves resulting in a biophysical change [1]. The gradual breakdown of these molecular bonds destroys the templates used by the body to make DNA and RNA (the information-carrying molecules in the cell) or causes abnormal cell division. The gradual natural breakdown of DNA and RNA is probably the cellular phenomenon associated with what we know as ageing. It occurs gradually over the years with exposure to natural background radiation from the radioactive substances which have been a part of the earth for all known ages [2]. From this point the importance of this radiation study is came, which included thirteen samples of local and imported chicken meat available in the markets of Karbala province, The aim of the present work is to measurement the specific activity of (238U, 232Th and 40K), and values of the hazard indices [Raeq, Hin, Iɣ, Iα Dɣ, EFF dos and AGDE] for all chicken meat samples studied, by using (NaI (Tl)) with a crystal detector of (3"×3").

2. SAMPLES COLLECTION AND PREPARATION

The samples that have been prepared were from local and imported origins, as mentioned previously. Where, we have boiled the meat samples and separated the bones from the meat, and then we have dried up the meat by exposing it to heat for time longer than the previous ways and then put the sample directly under the sunlight until we get the wanted drying. The dried samples become ready to be grinded and to be measured by gamma spectroscopy technical. The feed of chicken is given by two stages; the first stage is given to the chick in order to grow up as soon as possible, and then at the second stage the feed is composed of protein and analog energy in order that chicken become ready for human consumption. The samples of feed is prepared and measured by gamma spectroscopy technical. The Figure (1) shows the preparing of the chicken meat samples.

Fig. 1. Preparing the chicken meat samples.

2. 1. Activity Concentration

Since all the elements of radioactive chains effective in the case of late balance so it is possible to calculate the concentration of an element in the series in terms of the concentration of another element, it has been the focus of effectiveness of a Potassium-40, Bismuth-214 related to the Uranium-238 series, and Thallium-208 related the Thorium series in all chicken meat samples, and then the concentration of Potassium-40 account radioactive nuclide (1460 keV) can be effective concentration is calculated by the following equation [3]:

$$A = \frac{NET}{\varepsilon * I_{\gamma} * m * t}$$

where:
A: activity concentrations of the sample units Bq/kg, ε: Energy efficiency,
m: mass of sample units kg, *t*: time measurement (7200 sec.).

3. RADIATION HAZARD INDICES

3. 1. Radium Equivalent

Radium equivalent calculation from the following equation [4]:

$$Ra_{eq}(\text{Bq/kg}) = A_U + 1.43A_{Th} + 0.077A_K \quad (2)$$

where: AU, ATh, Ak activity concentration of a series of Uranium and a series of Thorium and Potassium, respectively, in the equation (2) Assume that (10 Bq/kg) of Uranium and (7 Bq/kg) of Thorium and (130 Bq/kg) of Potassium produces an equal dose of radiation [5].

3. 2. Absorbed Dose Rate

The total rate of the absorbed dose in the air is calculated in terms of the concentrations of (238U, 232Th and 40K), through the following equation [5]:

$$D_{\gamma} = 0.462A_{Ra} + 0.604A_{Th} + 0.0417A_K \quad (3)$$

3. 3. The Annual Effective Dose

The annual effective dose rate outdoor in air can be estimated using the absorbed dose and take into account two factors; conversion factor of 0.7 $SvGy^{-1}$ and the occupancy factor for outdoor 0.2. The annual effective dose equivalent outdoor (AEDEout) in unit of $\mu Sv.yr^{-1}$ is given by the following formula [6].

$$E_{out}(\text{mSv/y}) = D(\text{nGy.h}^{-1}) \times 10^{-6} \times 8760(\text{h/y}) \times 0.20 \times 0.7(\text{SvGy}^{-1}) \quad (5)$$

where: the 8760 refers to the number of hours a year. The global average annual effective dose is 0.48 mSv.

3. 4. External Hazard Index

The external guide is a hazard assessment of the risk of natural gamma radiation, is calculated from the following equation [7]:

$$H_{ex} = \frac{A_{Ra}}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad (6)$$

where: this factor must be less than one, if equal to or greater than one indicates the presence of radiation risk.

3. 5. Activity Concentration Index (Iɣ), (Iα)

The activity index (Iɣ) and Alpha index (Iα) was calculated by using the following equation [7]:

$$I_\gamma = \frac{A_U}{300} + \frac{A_{Th}}{200} + \frac{A_K}{3000} \quad (7)$$

$$I\alpha = \frac{A_{Ra}}{200} \quad (8)$$

3. 6. Internal Hazard Index

The internal exposure is caused by the inhalation of radon gas and daughters which can be expressed in terms of the internal hazard index and calculates by the following equation [8]:

$$H_{in} = \frac{A_{Ra}}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad (9)$$

and this factor must be less than the one to be within the allowable universally border.

4. RESULTS AND DISCUSSION

Gamma-ray spectrum of one of the studied Chicken samples is shown in Figure (2). It's clear the photopeck of the three detected radionuclides. Each of them was distinguished by a color different from the others as well as from the total spectrum. The specific activities of the detected radionuclides with codes of the samples besides the maximum, minimum, mean, standard errors and the word wide mean are shown in table (1).It is clear that the highest value of specific activity of (40K) was found in KC3 sample which was equal to (93.768 Bq/kg), while the lowest value of specific activity of (40K) was found in KV21 sample which was equal to (0.436 Bq/kg), with a mean value of (14.272±14.7 Bq/kg).

Twenty four of the suitable radiation hazard indices were be calculated in this study depending on the results of the specific activities of the chicken meat samples. Table (2) summarizes the results obtained for radiation hazard indices (Raeq, Hin, Iɣ, Iα DɣE, Eff dos and AGDE). From Table (2) it can be noticed that, the highest value of radium equivalent activity

was found in KW14 sample which was equal to (15.178 Bq/kg), while the lowest value of Raeq was found in KV21 sample, which was equal to (0.218 Bq/kg), with a mean value of (5.21±3.5 Bq/kg).The highest value of internal hazard index was found in KBT18 sample which was equal to (0.069), while the lowest value of Hin was found in KV21 sample which was equal to (0.001), with a mean value of (0.02±0.004). Also from Table (2), it can be noticed that, the highest value of activity concentration index was found in KW14 sample which was equal to (0.05), while the lowest value of Iɣ was found in KV21 sample which was equal to (0.001), with a mean value of (0.014±0.003). The highest value of Alpha index in the studied samples was found in KBT18 sample which was equal to (0.062), while the lowest value of (Iα) was found in FB6 sample which was equal to (0.0), with a mean value of (0.01±0.002).

The highest value of absorbed gamma dose rate was found in KC3 sample which was equal to (7.273 nGy/h), while the lowest value of Dɣ was found in KV21 sample which was equal to (0.103 nGy/h),with a mean value of (2.44±0.49 nGy/h). For annual effective dose rate, the highest value of annual effective dose rate was found in KC3 sample which was equal to (0.009 mSv/y), while the lowest value of EFF dos was found in KV21 sample which was equal to (0.0001 mSv/y), with a mean value of (0.003±0.001 mSv/y). The highest value of annual effective dose equivalent was found in KC3 sample which was equal to (0.052 mSv/y), while the lowest value of AGDE dos was found in KV21 sample which was equal to (0.001 mSv/y), with a mean value of (0.02±0.003 mSv/y). The present results have shown that values of hazard indices for ([Raeq, Hin, Iɣ, Iα Dɣ, EFF dos and AGDE], respectively, in all chicken meat samples studied were less than the recommended for the hazard indices given by (UNSCEAR, 2000) .

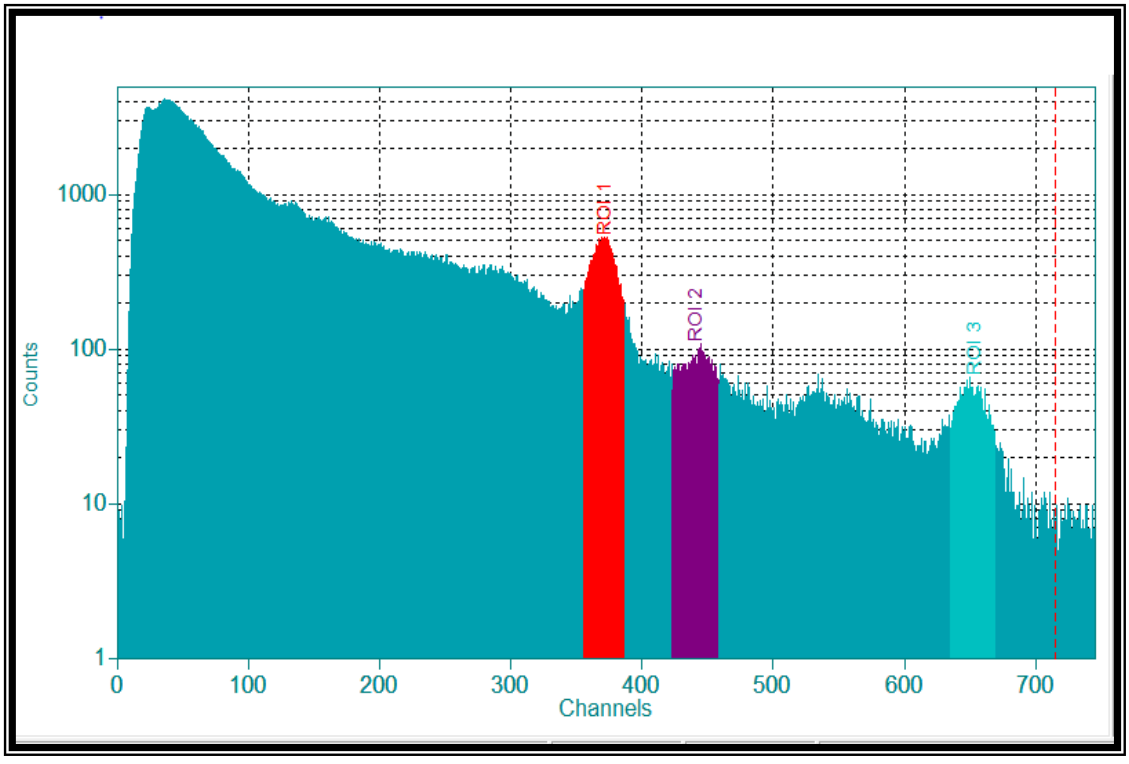

Fig. 2. Specific activity of (40K, 238U, and 232Th) for KW15 sample.

Table 1. The specific activities of the chicken samples.

No.	Code	40K (Bq/kg)	Uranium series 214Bi (Bq/kg)	Thorium series 208Tl (Bq/kg)
1	KCL1	10.083	0.817	0.205
2	KC2	25.177	5.804	0.280
3	KC3	93.768	2.255	3.738
4	KC4	21.051	0.173	0.874
5	KC5	3.838	1.257	0.015
6	KTL6	8.466	1.255	0.650
7	KT7	3.532	0.236	0.205
8	KT8	2.526	1.956	0.119
9	KT9	1.695	B.D.L	2.128
10	KT10	1.051	1.974	0.160
11	KT11	2.754	0.831	1.306
12	KWL12	41.922	B.D.L	1.571
13	KW13	10.894	1.281	0.971
14	KW14	10.265	4.930	6.614
15	KW15	1.186	5.664	0.807
16	KWI6	0.878	1.363	0.167
17	KBT17	8.838	4.144	1.125
18	KBT18	5.404	12.305	0.444
19	KBWL19	8.500	4.552	3.294
20	KBW20	66.419	1.089	2.229
21	KV21	0.436	0.170	0.010
22	KBL22	4.335	0.783	1.765
23	KB23	5.319	0.776	2.349
24	KH24	4.194	0.510	0.167
Max.		93.768	12.305	6.614
Min.		0.436	0.170	0.01
Mean ±S.E.		14.272±14.2	2.255±0.45	1.300±0.26
Worldwide mean [9]		400	35	30

Table 2. The hazard indices [Raeq, Hin, Iɣ, Iα DɣEFF dos and AGDE] for the all chicken meat samples.

No.	Code	Raeq (Bq/kg)	Hin	Iγ	Iα	Dγ (nGy·h^{-1})	Eff dose (mSv·y^{-1})	AGDE (mSv·y^{-1})
1	KCL1	1.887	0.0073	0.004	0.004	0.925	0.001	0.007
2	KC2	8.143	0.038	0.022	0.029	3.905	0.005	0.027
3	KC3	14.821	0.046	0.029	0.011	7.273	0.009	0.052
4	KC4	3.044	0.009	0.006	0.0009	1.501	0.002	0.011
5	KC5	1.574	0.008	0.004	0.006	0.750	0.001	0.005
6	KTL6	2.837	0.011	0.008	0.006	1.337	0.002	0.009
7	KT7	0.801	0.003	0.002	0.001	0.384	0.0005	0.003
8	KT8	2.320	0.012	0.007	0.010	1.083	0.001	0.007
9	KT9	3.174	0.009	0.011	0	1.392	0.002	0.009
10	KT10	2.284	0.012	0.007	0.010	1.055	0.001	0.007
11	KT11	2.911	0.010	0.009	0.004	1.310	0.002	0.009
12	KWL12	5.474	0.015	0.009	0	2.724	0.003	0.020
13	KW13	3.508	0.013	0.009	0.006	1.649	0.002	0.011
14	KW14	15.178	0.054	0.050	0.025	6.813	0.008	0.046
15	KW15	6.909	0.034	0.023	0.028	3.167	0.004	0.021
16	KWI6	1.669	0.008	0.005	0.007	0.770	0.001	0.005
17	KBT17	6.434	0.029	0.020	0.021	2.982	0.004	0.020
18	KBT18	13.356	0.069	0.043	0.062	6.186	0.008	0.042
19	KBWL19	9.918	0.039	0.032	0.023	4.504	0.006	0.030
20	KBW20	9.391	0.028	0.017	0.005	4.6573	0.006	0.033
21	KV21	0.218	0.001	0.001	0.001	0.103	0.00013	0.001
22	KBL22	3.641	0.012	0.012	0.004	1.639	0.002	0.011
23	KB23	4.544	0.014	0.015	0.004	2.039	0.003	0.014
24	KH24	1.072	0.004	0.003	0.003	0.514	0.001	0.004
Max.		15.178	0.0694	0.050	0.062	7.273	0.009	0.052
Min.		0.218	0.0010	0.001	0	0.103	0.0001	0.001
Mean± S.E.		5.21± 1.04	0.02± 0.04	0.014± 0.003	0.01± 0.002	2.44± 0.49	0.003± 0.001	0.02± 0.003
Worldwide mean [9]		370	≤1	≤1	≤1	55	1	0.3

5. CONCLUSION

The present results have shown that values of hazard indices for ([Raeq, Hin, Iɣ, Iα DɣEFF dos and AGDE], respectively, in all chicken samples studied were less than the recommended for the hazard indices given by (UNSCEAR, 2000).

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