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## The Determination of Radon Activity Concentration in local and imported fish of Basra Governorate/(Iraq) by Using SSNTDs Technique

Dh. J. Salman and I. J. M. Al-Khalifa

*Department of Physics, College of Education for pure Sciences, University of Basra, Basra, Iraq*

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### Abstract

The aim of this study is to determine radon concentration in local fish in Basra (Iraq) and imported fish. The passive radon method employed has been achieved by means of cylindrical time integrated technique of Solid State Nuclear Track Detectors (SSNTDs). The obtained radon concentration ranged from (309.4 Bq/m<sup>3</sup>) to (1600 Bq/m<sup>3</sup>) in local fish and from (507.3 Bq/m<sup>3</sup>) to (1100 Bq/m<sup>3</sup>) in imported fish. From the measurements all of the fish measured were within permissible level recommended by ICRP(1987 ) for foods [12]. This study gives us data base about the concentration of radon in fish found in Basra fish markets, and compares this data with radon data in vegetable of Basra markets.

**Key words:** Radon concentration ,local and imported Fish, SSNTDs, cylindrical time integrated technique.

### 1.Introduction

Radiation is all around us. It is naturally present in our environment and has been since the birth of this planet. Consequently ,life has evolved in an environment which has significant levels of ionizing radiation. It comes from the ground (terrestrial), outer space (cosmic),and even from within our own bodies. It is present in the air we breathe, the food we eat ,the water we drink, and in the construction materials used to build our homes. Levels of natural or background radiation can vary greatly from one location to the next[1].

Radon is available naturally in air wherever uranium laden soil or rocks are available as far as it is the descendant of U<sup>238</sup> .

Radon is a fascinating type of element in which it is the only massive radioactive inert gas found everywhere in different proportions. This special property of radon makes it too unique. Radon is colorless, odorless and tasteless element. When it is cooled below the freezing point, it has a brilliant phosphorescence which turns yellow as the temperature is lowered and orange- red at the temperature air liquefies. Radon and its isotope thoron are the only gaseous descendants of radium found in any

terrestrial material initially being part of the soiled matrix of the soil.

Then the earth is responsible for the emission of radon and thoron to the water and the atmosphere around us. As there parent decay, radon and thoron recoil and it could happen that they might escape from the soil matrix and join the water of seas and rivers as well as atmosphere.

The exposure of human beings to the ionizing radiation from natural sources is a continuing and inescapable feature of life on earth. For most individuals, this exposure exceeds that from all man-made sources combined .There are two main contributors to natural radiation exposure: high –energy cosmic ray particles incident on the earth's atmosphere and radioactive nuclides that originated in the earth's crust and present everywhere in the environment, including the humans body itself. Both external and

internal exposures to humans arise from these sources[2]. One kind of radiation is radon gas, it formed high relation from back ground. Radon is an odorless radioactive noble gas. Radon ( Rn 222) is a natural radioactive inert gas occurring from the disintegration of radium (Ra226) which is itself a decay product of uranium (U238) [3]. It emanates from soil and water and produces decay products in the air [4]. In the last decade there are great studies to measure the radon concentration in different materials, water and vegetables[7,8,9,10,11]. In this work, we report the results of preliminary test survey carried out using SSNTDs determine radon levels in fish as many as it was possible. As well are compare the results of radon measurements of the fish with data available in vegetables and fruit.

**2.Materials and Method**

Fish samples have been selected from different markets of fish in Basra Governorate(Iraq). There are two kinds of fish in the markets the frozen one was imported and fresh local fishing. Each type of fish are taken separately and made ashes of that fish using oven at 270C degree for 4 hours. These ashes placed in a closed cylindrical plastic container as shown in Fig(1). The closed container containing CR -39 and LR-115 type II (1.5 cm ×1 cm) is left for three months. Within these three months alpha particles emitted from radon, thoron and their corresponding daughter bombard the SSNTDs detectors and registered on the detectors. At the end of exposure time the samples are taken out.

The detectors of CR-39 and LR-115type II etched in NaoH solution (2.5N at 60°C for 2 hr for the LR-115type II detectors and 6.25N at 70 for 7 hr for the CR-39 detectors)[5]. The registered tracks were counted by optical microscope type ALTAY made in Japan. Where the track density for CR-39 and LR-115 type II were calculated. Using Misdaq and Satif equations [6] to determinate the ratio of (Ac<sup>220</sup>/Ac<sup>222</sup>) and (Ac<sup>222</sup>) have been determined, where (Ac<sup>222</sup>) is the activity of radon concentration per unit volume and (Ac<sup>220</sup>) is the activity of thoron concentration per unit volume of fish samples using the following equations after Misdaq and Satif [6].

$$\frac{\rho_G^{CR}}{\rho_G^{LR}} = \frac{\sum_{i=1}^3 k_i P_i^{CR} R_i + \frac{A_c^{220}}{A_c^{222}} \sum_{i=1}^4 k_i P_i^{CR} R_i}{3P^{LR} \Delta R + 4P^{LR} \frac{A_c^{220}}{A_c^{222}}} \dots \dots \dots (1)$$

And

$$\rho_G^{LR} = A_c^{222} (Bq.cm^{-3}) \left[ 3P^{LR} \Delta R + 4P^{LR} \Delta R \frac{A_c^{220}}{A_c^{222}} \right] \dots (2)$$

Where  $k_i$  is the branching ratio in % ,  $P_i^{CR}$  represents the probability for an  $\alpha$ -particle of energy  $E_{\alpha i}$  ,  $R_i$  is the range of the  $\alpha$ -particle of energy  $E_{\alpha i}$  and index  $i$  in the gas volume,  $P^{LR}$  represents the probability for an emitted  $\alpha$ -particle to reach and be registered on the LR-115 type II and

( $\Delta R = R_{max} - R_{min}$ ) where ( $R_{max}$ ) and ( $R_{min}$ ) are the range of alpha particles in the gas volume which correspond to the lower and upper ends of the energy window which depends on the residual thickness of the LR-115 type II.

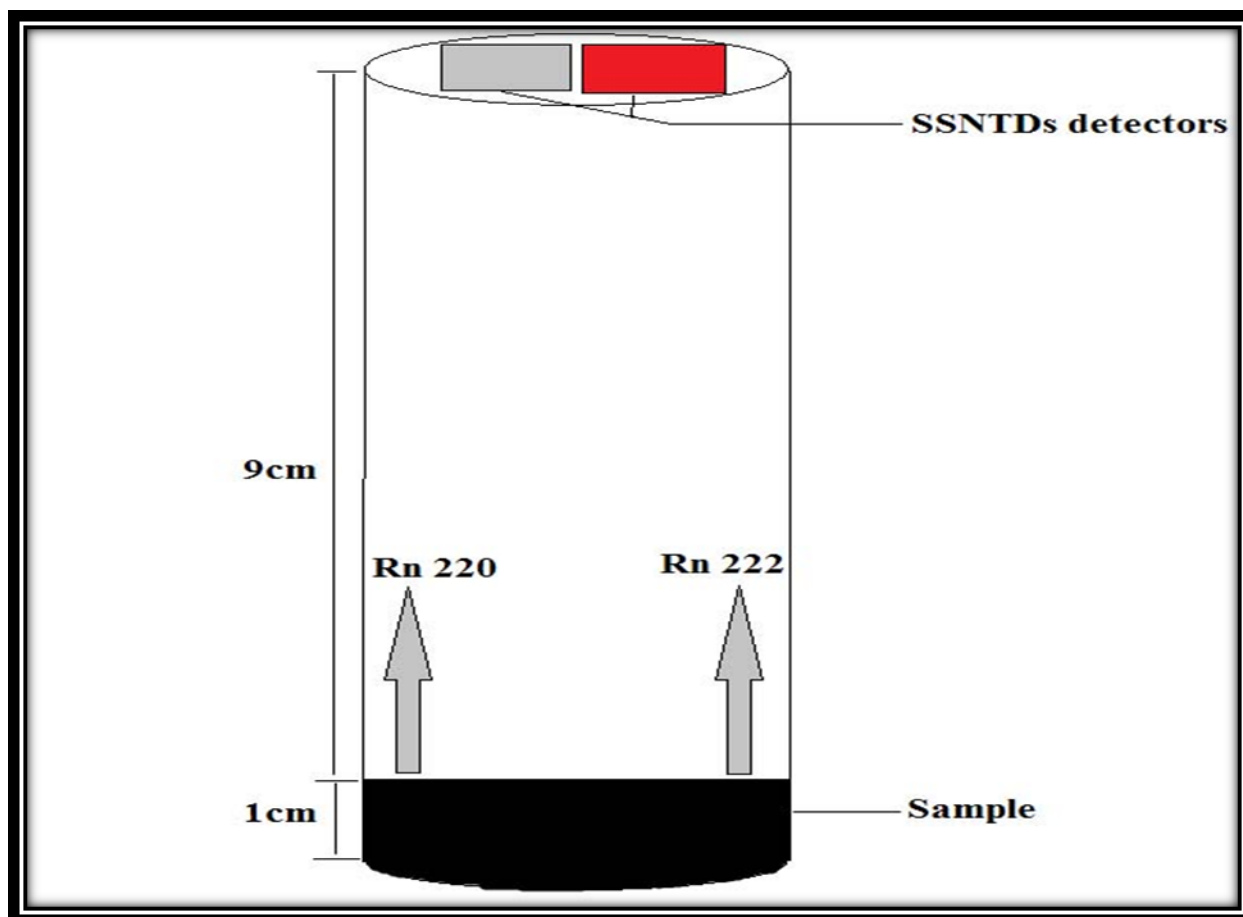


Figure (1) Arrangement of (SSNTDs) detectors placed at a distance of 9 cm above the ash of fish sample in a cylindrical plastic counter

### 3.Results and Discussion

Tables (1) and (2) shows the scientific fish name with sample No. ( $\rho_G^{LR}$ ) track density of LR-115 type II, ( $\rho_G^{CR}$ ) track density of CR-39 ,  $A_C^{220}/A_C^{222}$  the thoron

radon activity ratio and  $A_C^{222}$  radon activity, for local fish in table(1) and imported fish in table (2) respectively.

Table (1) Values of radon concentration in local fish

No. of sample	The scientific name of fish sample	$\rho_G^{LR} \times 10^{-5}$ (Tr.cm <sup>-2</sup> .s <sup>-1</sup> )	$\rho_G^{CR} \times 10^{-5}$ (Tr.cm <sup>-2</sup> .s <sup>-1</sup> )	A <sub>c</sub> <sup>220</sup> /A <sub>c</sub> <sup>222</sup>	A <sub>c</sub> Bq/m <sup>3</sup>
1	<i>Carassius auratus</i>	2.55	4.15	0.1850	596.5
2	<i>Liza abu(1)</i>	2.67	4.29	0.6566	415.2
3	<i>Acanthopagrus bifaciatus</i>	3.38	5.43	0.6646	522.6
4	<i>Tilapia zilli</i>	2.62	4.20	0.7950	370.8
5	<i>Aspius vorax</i>	2.60	4.25	0.0878	678.8
6	<i>Lutjanus russelli</i>	4.50	7.23	0.659	698.5
7	<i>Hypopthamichthys molitrix</i>	2.65	4.26	0.629	420.2
8	<i>Pseudorhombus arsius</i>	3.75	6.00	0.932	487.4
9	<i>Platycephalus indicus</i>	2.85	4.58	0.647	446.2
10	<i>Epinephelus sp.1</i>	2.34	3.80	0.241	516.2
11	<i>Pomadasy kaakaath</i>	3.10	5.00	0.473	554.4
12	<i>Lethrinus nebulosus</i>	2.28	3.65	0.891	309.4
13	<i>Acanthopagrus latus</i>	2.78	4.55	0.063	747.6
14	<i>Cyprinus carpio</i>	2.25	3.67	0.1327	557.6
15	<i>Polydactylus sextarius</i>	3.74	6.01	0.6494	584.6
16	<i>Megalaspis cordyla</i>	2.80	4.54	0.2860	591.2
17	<i>Penaeus semisulcatus</i>	5.41	8.78	0.2590	1200
18	<i>Parastromateus niger</i>	4.13	6.65	0.5482	695.9
19	<i>Liza subviridis</i>	5.25	8.49	0.372	1000
20	<i>Drepene punctata</i>	4.87	7.88	0.3524	966.3
21	<i>Saurida tumil</i>	2.35	3.77	0.747.2	343.2
22	<i>Carangoides malabaricus</i>	2.74	4.43	0.3801	530.3
23	<i>Cynoglossus arel</i>	4.00	6.45	0.4836	709.3
24	<i>Barbus grypus</i>	3.00	4.88	0.1970	692.9
25	<i>Scomberomorus guttatus</i>	2.71	4.42	0.1342	670.4
26	<i>Chirocentrus nudus</i>	2.55	4.15	0.1580	596.5
27	<i>Spairdentex hasta</i>	2.58	4.19	0.2398	570.1
28	<i>Barbus sharpeyi</i>	3.28	5.29	0.4756	585.4
29	<b>Un identified shrimp</b>	2.48	4.06	0.0587	670.8
30	<i>Otolithes ruber</i>	2.59	4.20	0.2824	548.7
31	<i>Argyrops spinifer</i>	2.88	4.72	0.0389	798.5
32	<i>Epinephilus sp.3</i>	2.51	4.08	0.2155	568.6
33	<i>Plectorhinchus sordidus</i>	2.24	3.66	0.0963	579.0
34	<i>Epinephelus .sp2</i>	1.60	2.59	0.3383	321.6
35	<i>Lethrinus lentian</i>	3.19	5.12	0.7183	475.2
36	<i>Euryglossa orientalis</i>	2.48	4.06	0.4730	443.5
37	<i>Ctenopharyngodon idella</i>	3.22	5.19	0.5023	562.4
38	<i>Barbus xanthopterus</i>	2.97	4.77	0.6803	454.2
39	<i>Johnius sina</i>	4.33	7.05	0.1742	1000
40	<i>Sillago arabica</i>	3.23	5.20	0.5023	562.4
41	<i>Tenualosa ilisha</i>	5.29	8.50	0.6544	823.9
42	<i>Thunnus sp</i>	3.88	6.31	0.2029	890.6
43	<i>Siganus canaliculatus</i>	5.34	8.54	0.9705	678.9
44	<i>Scomeroides commersonianus</i>	4.60	7.42	0.4694	825.1
45	<i>Tylosurus crocodilus</i>	3.65	5.94	0.1858	853.2
46	<i>Ilisha melastoma</i>	2.97	4.85	0.1080	757.2
47	<i>Sphyaena sp.</i>	2.51	4.08	0.2155	568.6
48	<i>Prepane longimana</i>	4.76	7.70	0.3614	936.8
49	<i>S.commersonianus</i>	2.53	4.10	0.3025	525.8
50	<i>Carangoides chrysophrys</i>	4.61	7.40	0.7112	690.1
51	<i>Eleutheronema tetradactylum</i>	3.41	5.53	0.2810	723.5
52	<i>Pseudorhombus</i>	2.57	4.17	0.2653	553.7
53	<i>Terapon jarbua</i>	2.94	4.77	0.2674	632.1
54	<i>Scarus persicus</i>	3.30	5.41	0.0335	921.3
56	<i>Abalistes stellatus</i>	3.39	5.50	0.2679	728.5
57	<i>Sepia sp.</i>	4.04	6.61	0.0697	1100

58	<i>Platax teira</i>	3.69	6.01	0.1661	881.1
59	<i>Pomacanthus maculosus</i>	3.76	6.05	0.5819	617.5
60	<i>Hiniochus acuminatus</i>	4.55	7.35	0.4120	856.5
61	<i>Tenualosa ilisha</i>	6.80	10.98	0.4281	1300
62	<i>Diplodus sargus</i>	6.55	10.49	0.8612	889.2
63	<i>Diagramma pictum</i>	5.01	8.08	0.4764	893.6
64	<i>Liza abu</i> (2)	6.38	10.24	0.7183	950.5
65	<i>Lthrinus nebulosus</i>	4.08	6.62	0.2656	878.8
66	<i>Upeneus . sp(1)</i>	6.24	10.06	0.4921	1100
67	<i>Pampus argenteus</i>	6.15	10.00	0.2510	1300
68	<i>Nemipterus japonicas</i>	6.25	10.02	0.7894	888.1
69	<i>Upeneus . sp(2)</i>	6.09	9.81	0.5290	1000
70	<i>Trichurus lepturus</i>	5.87	9.55	0.1932	1400
71	<i>Scotophagus argus</i>	5.86	9.56	0.2274	1200
72	<i>Liognathus bindus</i>	7.19	10.43	0.0653	1600
73	<i>Thryssa whiteheadi</i>	5.63	9.01	0.9157	739.3
74	<i>Rachycentron canadum</i>	4.39	7.12	0.0031	1300
75	<i>Nematalsa nasus</i>	3.99	6.46	0.3856	768.6

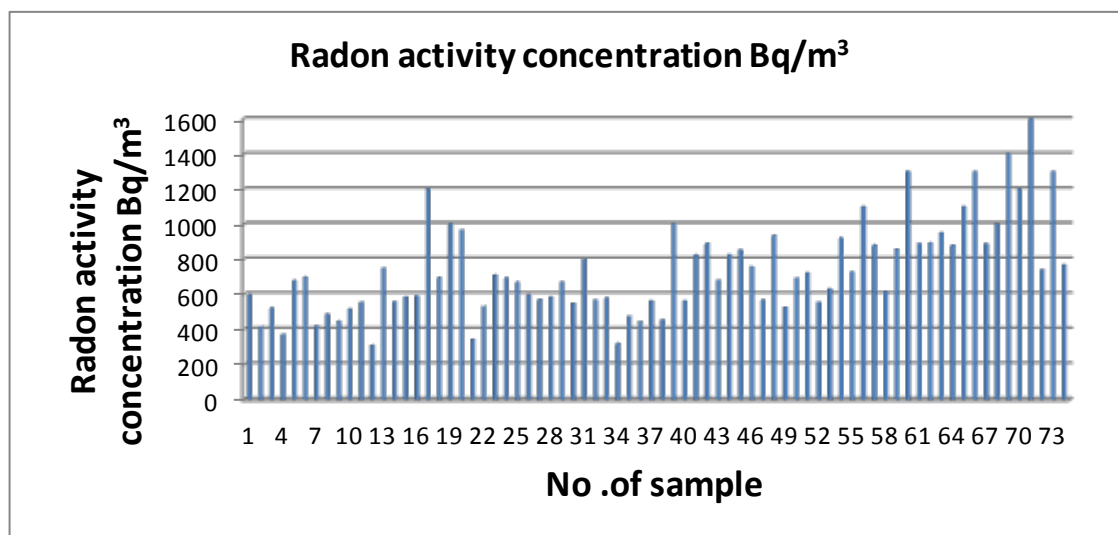


Figure (2) radon activity concentration in local fish.

In table (1) we noted that the( $A_c^{222}$ ) is (1600 Bq/m<sup>3</sup>) in sample(72) for *Liognathus bindus* which represents maximum value

while the minimum value was (309.4 Bq/m<sup>3</sup>) in sample(12) for *Lethrinus nebulosus* as shown in figure (2).

Table(2) Values of radon concentration in imported fish.

No.of sample	The scientific name of samples	$\rho_G^{LR} \times 10^{-5}$ (Tr.cm <sup>-2</sup> .s <sup>-1</sup> )	$\rho_G^{CR} \times 10^{-5}$ (Tr.cm <sup>-2</sup> .s <sup>-1</sup> )	$A_c^{220}/A_c^{222}$	$A_c^{222}$ Bq/m <sup>3</sup>
1	<i>Johnius sina</i>	4.27	6.98	0.0873	1100
2	<i>Orochromus sp</i>	5.03	8.06	0.8235	699.2
3	<i>Pampus argenteus</i>	4.76	7.72	0.2783	1000
4	<i>Otolithes ruber</i>	4.99	8.11	0.2195	1100
5	<i>Aearthopagrus latus</i>	4.07	6.60	0.2824	862.3
6	<i>Epinphilul</i>	5.47	8.82	0.4854	968.5
7	<i>Megalaspis cordyla</i>	3.87	6.24	0.4861	684.8
8	<i>Cenopharyngodon sp</i>	4.98	8.09	0.2319	1100
9	<i>Catla catla</i>	3.75	6.13	0.0872	979.8
10	<i>Tenualos ailisha</i>	3.67	5.88	0.8324	507.3

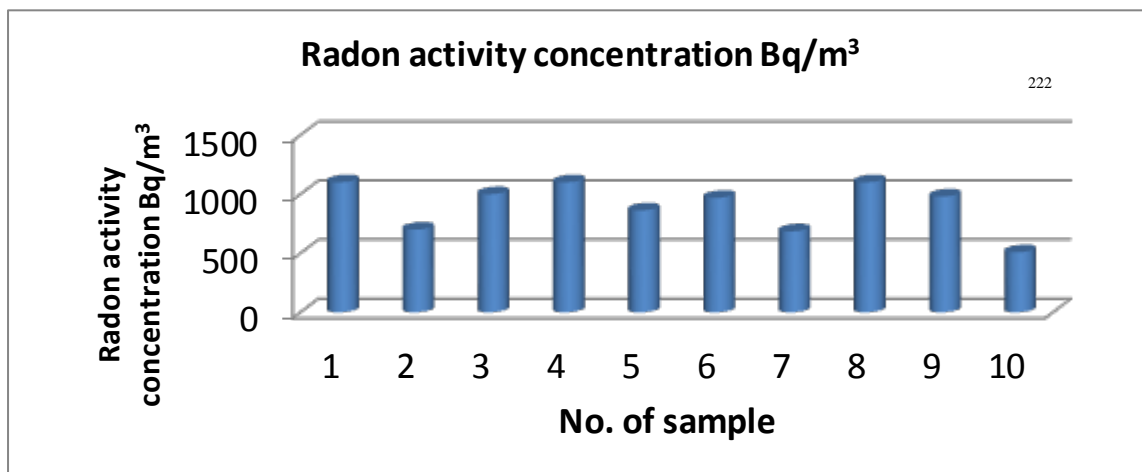


Figure (3) radon activity concentration in imported fish

While table (2) shows the result of the imported fish which was about in between maximum value (1100Bq/m<sup>3</sup>) for samples (No.1,4,8) for *Johnius sina*, *Otolithes ruber* and *Ctenopharyngodon sp* and minimum value (507.3Bq/m<sup>3</sup>) for sample(10) for *Tenualos ailisha* as shown in figure (3).

Al-Khalifa et al .,(2010) studied the (Radon concentration in fruits and vegetables ) and got the result (177Bq/m<sup>3</sup>) as high value in local watermelon and (82 Bq/m<sup>3</sup>) as less value while the imported (155Bq/m<sup>3</sup>) in

#### 4.Conclusions

To conclude, the radon activity has been measured in most fish with include both local fish and imported. From the measurements all of the fish measured were within permissible level recommended by ICRP(1987 ) for foods[12].

It is therefore suggested that extensive study of radon activity in hatchery which are available throughout the country may be initiated. Determination of the uranium level is also necessary to be carried out the

china orange represents high value and (48 Bq/m<sup>3</sup>) in Turkish apple as minimum value [10].

Al-Khalifa et al .,(2010) studied (determined of radon activity in soil and natural water for rivers and wells of Basra Governorate ) concerning the available fish in the sea and the rivers in Basra such as Abu al khaseeb and Al faw found (558 Bq/m<sup>3</sup>) high value and (138 Bq/m<sup>3</sup>) minimum value[9].

study also show the nuclear track technique using CR-39 and LR-115 type II SSNTDs is a good tool to characterize the risk due to the radon emanation. It has the advantage to simple, inexpensive, sensitive and non-destructive.

This study is the first radon concentration measurements in local and imported fish in Basra Governorate markets of Iraq. and gave the data base for researchers in the field of Radon radioactivity.

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تحديد تركيز غاز الرادون في الاسماك المستوردة والمحلية في محافظة البصرة (العراق)  
باستخدام تقنية كواشف الاثر النووية الصلبة (SSNTDs).

الخلاصة:

تهدف هذه الدراسة الى تحديد تركيز الرادون في الاسماك المستوردة والمحلية في محافظة البصرة /العراق. انجزت هذه الدراسة بوساطة تقنية الاسطوانة التكاملية المغلقة لكواشف الاثر النووي الصلبة (SSNTDs) الطويلة الامد. في هذه الدراسة تراوحت قيم تركيز غاز الرادون بين ( $309.4 \text{ Bq/m}^3$ ) و ( $1600 \text{ Bq/m}^3$ ) في الاسماك المحلية, اما في الاسماك المستوردة فقد تراوحت قيم تركيز غاز الرادون بين ( $507.3 \text{ Bq/m}^3$ ) و ( $1100 \text{ Bq/m}^3$ ). وبشكل عام اثبتت الدراسة بان الاسماك المحلية والمستوردة بالرغم من اختلاف تراكيز الرادون فيها الا انها ضمن القيم المسموح بها في المواد الغذائية وحسب ICRP . توفر هذه الدراسة لنا قاعدة بيانات لتراكيز الرادون في الاسماك الموجودة في اسواق البصرة ومقارنة هذه البيانات مع بيانات الخضروات في هذه الاسواق.