# Determination of radioactive concentrations in Carpio fish Samples In Baghdad Province

# تحديد التركيزات المشعة لعينات اسماك الكارب في محافظة بغداد

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## Abstract:

In this study, the concentrations of radioactive including $^{40}$K $^{226}$Ra, and $^{232}$Th in some tissues of most common Carpio fish collected from Baghdad city and their in Tiger river which is an important water source for irrigation and drinking in in Iraq during 2015-2016 were investigation and studied using a high purity germanium detector .

The results of fish sample obtained showed that the the effective activity concentration of $^{40}K$ : 97.65 Bq/kg in $S_5$ sample to 567.34 Bq/kg in $S_9$ , $^{226}Ra$ : 1.17 in $S_3$sample to 33.51Bq/kg in $S_9$ sample, and $^{232}Th$ are 2.39Bq/kg in $S_9$ to 11.89 Bq/kg in $S_5$ sample . These confirm that that never affected on the integrity of the environment and fisheries at Baghdad province, its indication a certain degree of bio-accumulation. That's refers to conditions will help the fish to withstand sudden changes if available oxygen generators .

**Keywords: radioactive concentrations , Carpio fish , Baghdad Province**

**الخلاصة**

في هذه الدراسة فان تركيزات المواد المشعة والمتضمنه($^{40}K$ $^{226}Ra$ $^{232}Th$) في بعض أنسجة اسماك الكارب الأكثر شيوعا و التي تم جمعها وللفترة 2015-2016في مدينة بغداد و في نهر دجله الذي هو مصدر المياه الرئيسي و المهم لأغراض الري والشرب في العراق

وقد درست ووفحصت باستخدام كاشف الجرمانيوم عالي النقاء.

وأظهرت نتائج العينات للأسماك الكارب التي تم الحصول عليها أن تركيز النشاط الفعال ل ($^{40}K$) 97.65 بيكايريل/كغم للنموذج الخامس الى567.34 65 بيكايريل/كغم للنموذج التاسع وللراديوم $^{226}Ra$ من 1.17 بيكايريل/كغم للنموذج الثالث الى 33.51 بيكايريل/كغم للنموذج التاسع و$^{232}Th$ من2.39 بيكايريل/كغم للنموذج التاسع الى 11.89 بيكايريل/كغم للنموذج الخامس .

ان هذه الدراسة تؤكد أن هذا التراكيز الاشعاعيه لم تأثر على سلامة البيئة والثروة السمكية في محافظة بغداد،وهذا مؤشرا على درجة من التراكم الحيوي في الاسماك. ان هذا يشير إلى الأسماك تكون قادرةعلى تحمل التغيرات المفاجئة تحت شروط منها موزعات الأوكسجين المتاحة.

كلمات مفتاحيه: تركيزات مشعة،سمك الكارب ، محافظة بغداد.

## INTRODUCTION

Fish was consumed at more countries because the fish have been higher proteins supplies, vitamin, mineral content and essential amino acids,. The fish were exposeion to chemicals such as heavy metals in polluted and contaminated waters [1]. Pollution of the aquatic environment with heavy metals had been become a worldwide problems during recent years, because they are indestructible and most of them had been toxic effects on organisms. Among environmental pollutants, metals were of particular concern, due to their potential toxic effect and ability to bioaccumulation in aquatic ecosystems. The concentrations of heavy metals in aquatic ecosystems usually are monitored by measuring their concentrations in sediments, water and biota which generally exist in lower level in water and attain considerable concentration in sediment [2] . Water in river had been and was still being used to large purposes, which included irrigation, drinking, recreation ,animal farming, and habitat serves as to numerous organisms. The available of best qualities water was an indispensable feature for prevented the diseases and improvement the quality of life's [3]. The environment in aquatic with water quality was considering the main factors that controlling the state of health and diseases in both cultured and wild fish. Pollution of the aquatic environment due to organic and inorganic chemicals was a major factors posing serious threat to the survival of aquatic organisms including fish[4]. Sediments were important sinks for various pollutants like pesticides and heavy metals and also played a significant role in the remobilization of contaminants in aquatic systems under favorable conditions and in interactions between sediments and water [5]. Toxic elements such as lead and cadmium could causes mental and central nervous system damage. Its important to check and control heavy metal levels in seafood, because heavy metal ions can easily accumulate in fish more than other foodstuffs could been transmitted to and accumulated in organs of human body by their consumption. Fish was one of important foods to be eaten for a healthy lifes, therefore, heavy metals in food chain made threats to human health [6]. On the other hand, naturally occurring radionuclide's Uranium ($^{238}$U), Radium ($^{226}$Ra), Thorium ($^{232}$Th), and potassium ($^{40}$K) and the artificial radionuclides such as $^{137}$Cs in the environment could be concentrated in and transferred along the food chains, damaging biological effects on populations and ecosystems may come from these ionizing radiation [7]. The dose radiation is receiving and accumulation in the body by marine fauna comes from the naturally occurring uranium series, $^{210}$Po is alpha-emitting radionuclides and gives (90%) of the natural radiation dose receiving by most marine organisms and the artificial $^{137}$Cs has great abundant in the environment [8]. In this study, ten samples were analyzed to calculate the concentrations (Bq/Kg) dry weight of natural radionuclide $^{40}K$ $^{226}Ra$, and $^{232}Th$ in the Carpio fish samples were measured.

## Materials and Method

## Study Area

The study was carried out in Baghdad province which is located along the Tigers River and in the center of Iraq. It is the capital town of Iraq. The samples were collected from several sites at 10 sites at north, south, east, and west of Baghdad province .On the other hand ,the samples were taken during November 2015 to May 2016 in accordance to international standards where carp fish type was taken up to almost one kilogram at the rate of fish each aquarium [9].

The samples were said to be taken from the lakes that surrounded by a dense stretch of vegetation and agricultural farm. As for the water, 5-liters were taken from each aquarium as well as the background radiation for each examination site and test sites are calculated and represented

in the table (1) follows :

Table (1) the sites of which testing samples were collected from Baghdad city.

| Location | Sample Code |
|---|---|
| Abu Graib | $S_1$ |
| A Rashidya | $S_2$ |
| Al-yousifya | $S_3$ |
| Latifiya | $S_4$ |
| Madain | $S_5$ |
| Ara Jabour | $S_6$ |
| Al Wihda | $S_7$ |
| Tiji | $S_8$ |
| Jisir Diyala | $S_9$ |
| Al Tarmiyah | $S_{10}$ |

## Sample Collection and Treatment

Carpio fish samples was collecting in aquarium weighted one kilo and length varied from 11.7cm and 18 cm from many sites in Baghdad province that's shown in figure (A).

Figure (A):Different weights of Carpio fish.

Carp fish samples transport in the same day to laboratory and kept in ice thermos flask. It had been preparing according to international standards in the laboratory tests and they exposed to sun and hung down to completely dry out in 30-37 day depending on the size and fating of the Carp fish . Carp fish samples were milling to become a powder and packaged in the bags labeled by weight ,length and location codes of the site to tested by NaI detector system . Before analytical fish

sample, the chemical testing for the Carpo fish was fulfillment by taking one gram of each dried sampling site prepared and ground fish using chemical digestion processes. A chemical digestion was using to preparing the samples for analysis were mixing one gram fish powder with5 ml of nitric acid HNO3 and 15 ml of HCL and heating to 550 C on electric heater. After evaporated samples , 5 ml of Antrim acid and 15 ml of HCL were added to remaining part of it. After completely dissolved of mixing, the solution was filtering by filter paper in a volumetric flask until record up to 100 ml and samples were placed in a plastic to the chemical examination using atomic absorption device to examine the chemical elements of the Fish [10]

## Calculations

1) Determine of hazard Indices in Carpio fish samples:

One important index that may be using to investigate the risk by metals of presenting the exterior exposing and named the exterior risk index .Its calculation by [11].

$$HI_{ex} = \frac{A_{Ra}}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \quad \text{.....(1)}$$

Where $A_{Ra}$ , $A_{Th}$ and $A_K$ are activation of $^{226}Ra$ , $^{232}Th$ and $^{40}K$ .

On the other hand ,the interior risk index that exposing to radon and written as [11] .

$$HI_{int} = \frac{A_{Ra}}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \quad \text{.....(2)}$$

The gamma radiation hazard index $I_\gamma$ [12].

$$I_\gamma = \frac{A_{Ra}}{150} + \frac{A_{Th}}{100} + \frac{A_K}{1500} \quad \text{.....(3)}$$

The counted of radiation hazard index $I_\gamma$ must be equally $I_\gamma \leq 1$ for the radiation risk

insignificant [13].

2) Activity Concentration

The specific activity of radiation could be written as [11].

$$A = \frac{C(E_\gamma)}{M\beta(E_\gamma)\epsilon(E_\gamma)} \quad \text{.....(4)}$$

Where $C(E_\gamma)$ is the count of net peak area per second at energy($E_\gamma$), M is the mass fish sample ,$\beta$ is the the transition probability of gamma-decay at energy $(E_\gamma)$ and $\epsilon$ is the detector efficiency at energy $(E_\gamma)$. On the other hand ,the estimation of the risk that connect with $^{226}Ra$ , $^{232}Th$ and $^{40}K$ substance named Radium equivalent activity in (Bq/kg)and given by [14].

$$R_{equ} = A_{Ra} + 1.43A_{Th} + 0.077A_K \quad \text{.....(5)}$$

Whereas, $A_{Ra}$, $A_{Th}$ and $A_K$ are the specific activity of $^{226}Ra$ , $^{232}Th$ and $^{40}K$ and taken 10 B$q/\ k$g for $^{226}Ra$ ,7 B$q/\ k$g for $^{232}Th$ and 130 B$q/\ k$g for $^{40}K$ respectively [13 ].

3) Effective Dose rate (D) :

As a result of gamma radiations in air at 1m over the earth surface for the uniform separation of the naturally appearing the radio nuclides and takes the effective dose of the fish as $\leq 5\ years$[15] and the effective doses rate(nGy/h) are evaluated using [16].

$$D = 0.462A_{Ra} + 0.621A_{Th} + 0.0417A_K \quad \text{.....(6)}$$

4) Annual effective dose :

Annual radionuclide intakes and yearly influential effective doses of $Sv/\ y$ had been counting for Indoor effective dose by [17].

$$D_{Indor} = \left[D\left(\frac{nGy}{h}\right) \times 8760h \times 0.8 \times 0.7\frac{Sv}{Gy} \times 10^{-6}\right]\left(\frac{mSv}{y}\right) \quad \text{.....(7)}$$

And outdoor effective dose by [17].

$$D_{Outdoor} = \left[D\left(\frac{nGy}{h}\right) \times 8760h \times 0.2 \times 0.7\frac{Sv}{Gy} \times 10^{-6}\right]\left(\frac{mSv}{y}\right) \quad \text{.....(8)}$$

## Results and Discussion

Baghdad province and Tigris River were rich natural area for fisheries as well as of farm landing surrounding from every side of rivers and lakes at every sites. The radiological testing for all Carpo fish samples that's collection from lakes, plastic cages and natural rivers with the sampling sites (Al zafarinya , Al tajy , Salman Bak Al Yousifya ,Al halla, Al Husyniya , Al Rashidya ,Al Dora,Al Fathelia andAbu Khraeb) respectively. The radiological testing including the tests of the concentration activity of $^{40}K$, $^{226}Ra$ , and $^{232}Th$ ,the hazard index( $HI_{ex}$ and $HI_{int}$), the gamma radio hazard index ($I_\gamma$), the radium equivalent hazard index ($R_{equ}$) and the annual the effective doses rate $D$ for all samples in fish samples

Table 2 shows the the radiological testing corresponding to the effective Activation concentration (Bq/kg)for $^{40}K$ ranged at 97.65 Bq/kg in $S_5$ sample to 567.34 Bq/kg in $S_9$ with an overall average about 243.001Bq/kg while the ranged values of $^{226}Ra$were from 1.17in $S_3$sample to 33.51Bq/kg in $S_9$ sample, with an overall average about 9.551Bq/kg. The ranged of activation concentration (Bq/kg)for $^{232}Th$ ere 2.39Bq/kg in $S_9$ and the maximum value was 11.89 Bq/kg detected in $S_5$ sample, while the overall average value for all measured samples was 7.332Bq/kg. However, the important indices for testing the different Carpo fish sample such that $HI_{int}$ , $I_\gamma$ , $R_{equ}(\frac{Bq}{kg})$ , $D(\text{nGy/h})$ , $D_{Outdoor}(mSv/y)$ and $D_{Indor}(mSv/y)$ were estimated to known how can effective on human health .

The most important effective index is hazard index $HI_{int}$ that estimation using Eq.(2) and we show from table (2) the 0.0572mSv/y was minimum values that measured in $S_3$ sample and the maximum value was 0.3083μSv/y in $S_9$ sample, whereas the overall average value was 0.13037 mSv/y. On the other hand the figures (1) and (2) illustrated $D$(nGy/h for $^{40}K$ , $^{226}Ra$, and $^{232}Th$, respectively. Figure (3) showed the calculated results of$HI_{int}$ for all investigated fish samples.

Table (2) Results Data of radiological testing for Carpio fishes samples .

| Location | Sample Code | Effective Activation (Bq/kg) | | | $HI_{int}$ | $I_\gamma$ | $R_{equ}(\frac{Bq}{kg})$ | $D$(nGy/h) | $D_{Outdoor}(mSv/y)$ | $D_{Indoor}(mSv/y)$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $^{40}K$ | $^{226}Ra$ | $^{232}Th$ | | | | | | |
| Abu Graib | $S_1$ | 318.6 | 14.24 | 11.43 | 0.1873 | 0.42163 | 55.11171 | 26.96253 | 0.033066 | 0.1322 |
| A Rashidya | $S_2$ | 297.35 | 1.56 | 7.86 | 0.1005 | 0.28723 | 35.69575 | 18.00127 | 0.022076 | 0.088307 |
| Al-yousifya | $S_3$ | 157.20 | 1.17 | 4.73 | 0.0572 | 0.1599 | 20.0383 | 10.03311 | 0.012304 | 0.049218 |
| Latifiya | $S_4$ | 117.29 | 2.7 | 7.56 | 0.0681 | 0.1717 | 22.54213 | 10.83315 | 0.013285 | 0.053143 |
| Madain | $S_5$ | 97.65 | 19.37 | 11.89 | 0.1705 | 0.3131 | 43.89175 | 20.40463 | 0.025024 | 0.100096 |
| Ara Jabour | $S_6$ | 198.40 | 2.82 | 7.11 | 0.0839 | 0.2221 | 28.2641 | 13.99143 | 0.017159 | 0.068636 |
| Al Wihda | $S_7$ | 229.20 | 6.53 | 3.28 | 0.0956 | 0.2291 | 28.8688 | 14.61138 | 0.017919 | 0.071677 |
| Tiji | $S_8$ | 157.45 | 9.71 | 10.84 | 0.1270 | 0.2781 | 37.33485 | 17.783325 | 0.021809 | 0.0872378 |
| Jisir Diyala | $S_9$ | 567.34 | 33.51 | 2.39 | 0.3083 | 0.6255 | 80.61288 | 40.623888 | 0.049821 | 0.1992845 |
| Al Tarmiyah | $S_{10}$ | 289.53 | 3.90 | 6.23 | 0.1053 | 0.28132 | 35.10271 | 17.744031 | 0.02176 | 0.0870451 |
| Average | | 243.001 | 9.551 | 7.332 | 0.1303 | 0.29896 | 38.7463 | 19.09887 | 0.023422 | 0.093684 |

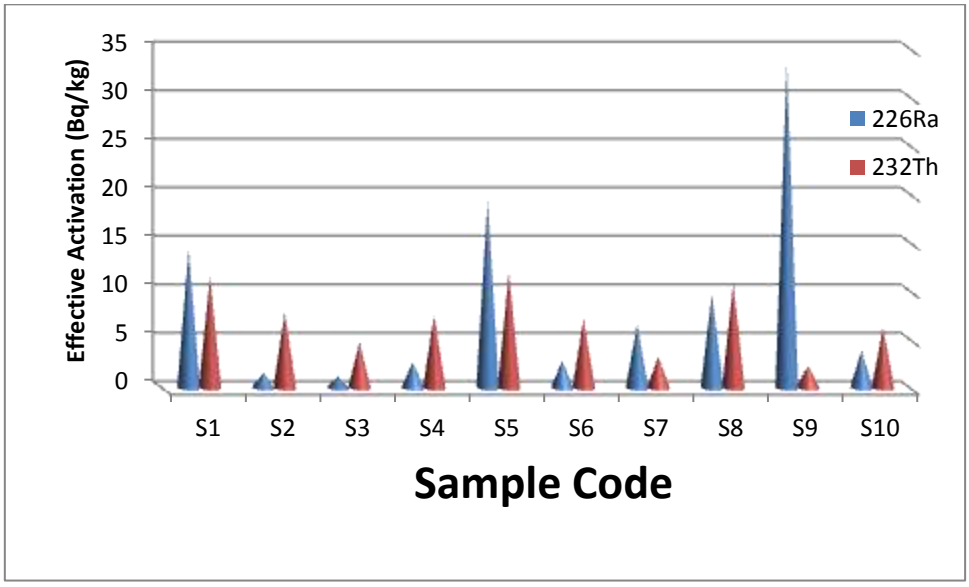



Figure (1):Activity Concentration of radiation for $^{226}Ra$, and $^{232}Th$, at Carpio fish sample .

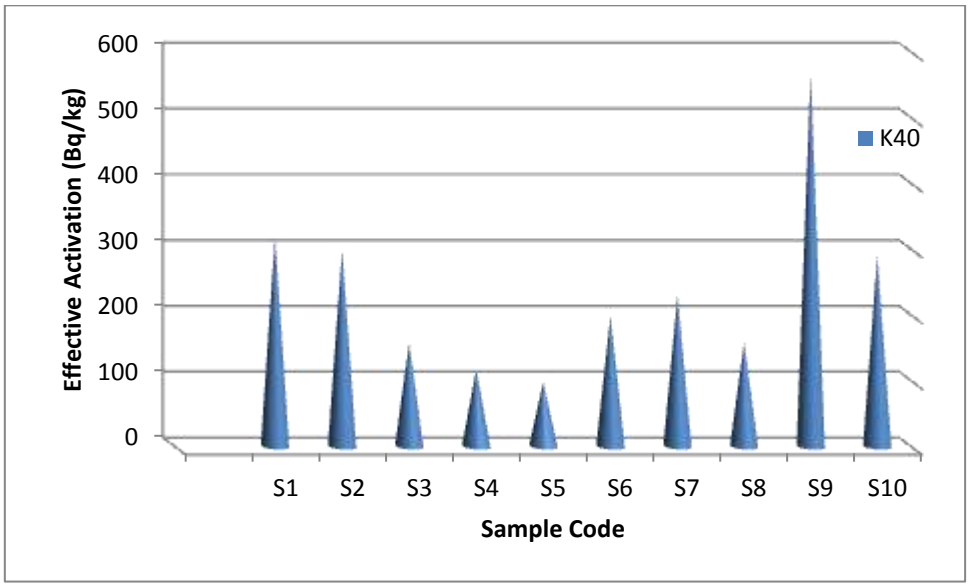



Figure (2): Activity Concentration of radiation for $^{40}K$ at Carpio fish sample.

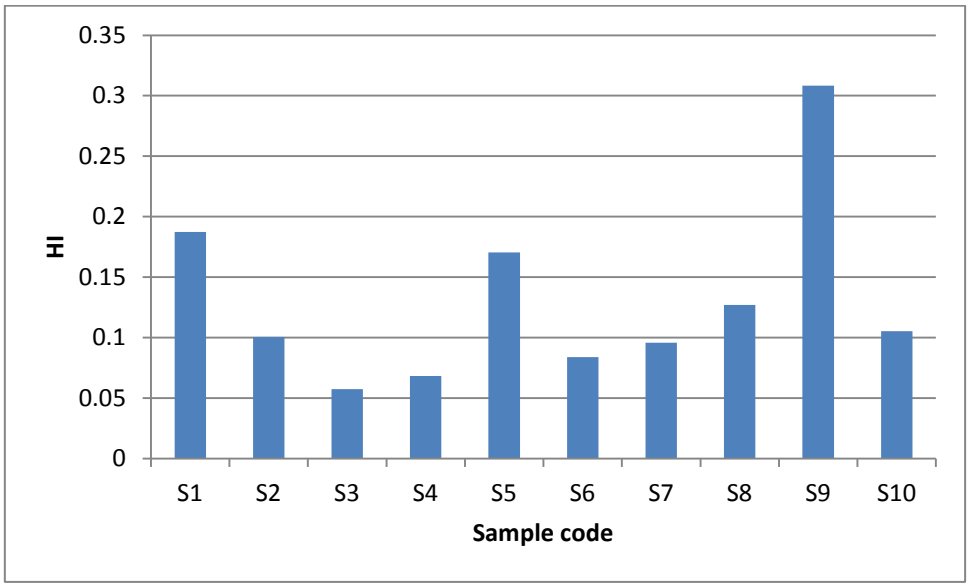
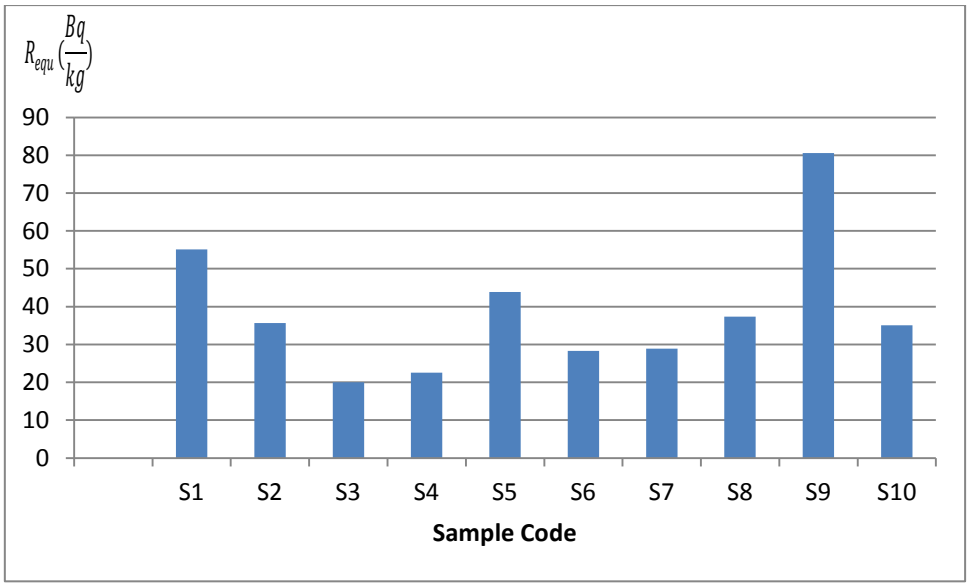



Figure (3): **The** hazard index estimation **for** Carpio fish sample.




Figure(4): Radium equivalent activity in (Bq/kg) at Carpio fish sample .

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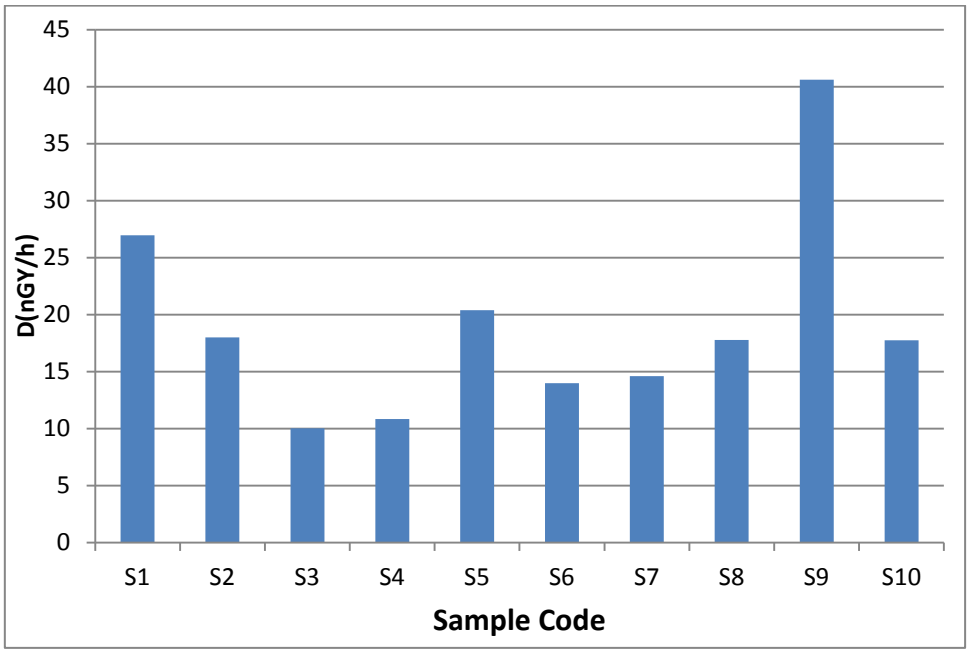


Figure(5): The effective doses rate(nGy/h) at Carpio fish sample .

Furthermore, the figure (3) show that the behavior of the hazard index in the consumers depending on the fish's environment samples. This index indicated that what type of the environment to produce fishes and refers the purity of Oxygen breathing by fish. Also ,this result indicate that the fish live in the cages was besting than revers' fishes ,that means the feeding of cages fishes depending on delivered provender while the fish in revers depend on the natural provender. The resulted of hazard index $HI_{int}$ that estimated for Carpio fish samples aren't affecting on human health because its less than one ($HI_{ex}$ <1) [18] .However, the best consuming fishes according to $HI_{int}$ is the fishes produced in Al-yousifya farms in samples $S_3$. This because the Oxygen breathing of that fishes farmers were providing by automatically machines and the fishers man are using locally provender mixed and prepared according to the advice of the specialists.

Figures (4) and (5) show that the Radium equivalent activity and the effective doses rate at Carpio fish sample are large for both samples $S_9$ and $S_1$ and lowering for sample $S_3$ Data result of effective activation (Bq/kg) for $^{40}K$ $^{226}Ra$, and $^{232}Th$ are approximately equally to Saudi Arabia kingdom and other Arab Gulf Countries .From health effective point, the estimated of $HI_{int}$ , $I_\gamma$, $R_{equ}(\frac{Bq}{kg})$ , $D$(nGy/h) , $D_{Outdoor}(mSv/y)$ and $D_{Indor}(mSv/y)$ was roughly lest than result of reference[18],this indicate that the produced fishes in Baghdad governorate are safe for consuming.

## Conclusions

This papers have been carried out to analyzing the **radioactive concentrations** (Bq/kg), and hazarded indices (HIs) of some $^{40}K$, $^{226}Ra$ , and $^{232}Th$ in ten Carpo fish samples. The results of concentrations of the radiological in all fish samples were of no risk to public health and allowed permissible international limits. The effective ingestion dose for samples shown a better gages fish and the sample $S_3$ was low hazarded indices in Al-yousifya farms.

All result that measurement and estimation showed that produced fishes from all lakes in Baghdad were safe level to use by Iraqi human consumers($HI$ < 1)

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