Uranium Concentrations Investigation in the chicken and their parts samples Using CR-39 detector in Nineveh Province, Iraq

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Chicken meat producers in Nineveh Province are in great demand for both organic and inorganic feeds that promote faster growth in chickens. Concerns over the quality of chicken meat and the potential for cancer and other biological consequences of radiation on consumers of chicken products are brought up by competition in the chicken producing industry. This study focused to determining the uranium concentrations in chicken meat and bones. Radiological risk parameters need to be determined in order to check the health risks to consumers of chicken products. The obtained mean radon concentrations were 44. 9565 Bq.m^{-3} which is below the world limit level of 100 Bq.m^{-3}. The mean uranium concentrations in were 8.53243 µg Kg^{-1}. The mean uranium activity concentrations value is 1.0529 Bq kg^{-1} which it's below the world average of 35 Bq kg^{-1}. The results indicates that the risk of increased uranium intake from chicken meat is almost very low so the studied area is safe.

Keywords: Radon concentration; Chicken; Chicken bones; Uranium concentration
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1. Introduction

One of the staple foods for human consumption is considered to be chicken meat worldwide [1]. Understanding uranium products' dispersion and toxicity to humans and animals is beneficial, as there is an increase in uranium products that can be eaten or inhaled that contain uranium oxides [2,3] and its capacity to infiltrate the food chain for humans. One of the main ways that uranium enters the food chain and contaminates animals is by eating it in their food, water, or soil [4]. Water tainted with uranium is the primary factor affecting the amount of uranium activity in chicken meat [5]. A combination of organic and inorganic substances are used to make chicken feed [6], instead of naturally occurring technologically enhanced radioactive materials (TENORMs), which could increase the amount of radionuclides in chicken feed, meat, and bones [7]. Plants are more likely to absorb radionuclides when fertilizers and agrochemicals are used in farming, which creates a pathway for radiation exposure to plants, chicken feed, and chicken products [8,9]. Phosphate fertilizers and other inorganic materials include TENORM, while organic substances contain NORM [10,11]. Chicken is exposed to radioactive elements by the NORM and TENORM components. Moreover, living things are put in danger when NORM is present in the environment at activity concentrations above the radiological reference limits set by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [12]. Due to the widespread distribution of radioactivity in the earth's environment, the planet is constantly exposed to radiation, primarily from man-made and natural sources [13,14]. The natural radioactivity of uranium and its offspring exposes people to biological consequences of radiation and cancer [15]. Roughly, 30% of cancer cases worldwide are caused by nutrition [16]. Urbanization and dietary changes have been identified as the main drivers of the general increase in cancer risk. As a result, dietary changes in lifestyle might cause the percentage to grow or decline [17].

The goal of this study was to measure the amounts of uranium and radon in typical chicken parts including meat and bones.

2. Experimental Part

Samples of fresh chicken flesh were collected from farms, after which the birds were slaughtered, feathered out, and given a water bath. For bone samples, fresh chicken meat pieces were boiled for 1 hour at 100°C to separate the bones from meat. Each sample of chicken was oven dried meat at 100°C for 2 hours, and bones at 200°C for 1 hour. After cooling, each sample was grinded into powder, and sieved. Each sample of feeds, meat and bones was then put in plastic can. The measurements of the CR-39 detector are made using a plastic can radon dosimeter (7 cm in diameter and 10 cm in length). The detector is put on the bottom of the dosimeter cover and is used to measure the radon concentration of the samples, as shown in (Fig. 1).

Samples with a volume of 115.4×10^{-6} m^3 and a height of 3 cm were placed in the dosimeter; the distance from the samples and the detector surface was 7 cm. The samples were kept in the plastic can for duration of 60 days exposure period. The detectors were taken out of the dosimeter and etched chemically in a 6.25N of NaOH solution at 70°C for seven hours. Utilizing a 400X optical microscope, the tracks were counted.

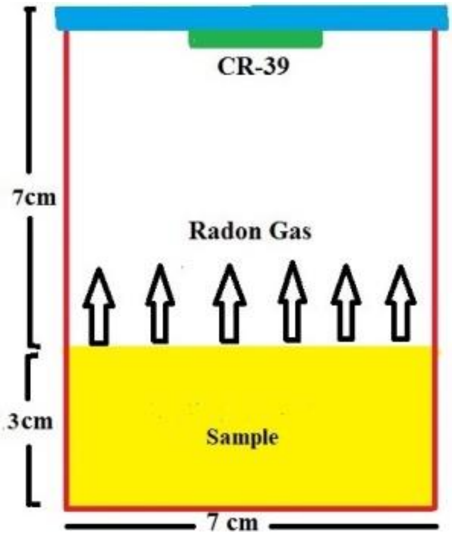

Fig. (1) The radon dosimeter

The radon concentration in the air volume within the container, as determined by the equation [18].

$$C_{Rn}=\rho[KT]^{-1} \quad (1)$$

where T is the exposure period, ρ is the track density, K (=0.05916 Tr/cm^2.d/Bq/m^3) is the radon dosimeter utilized in this study's CR-39 detector calibration factor [19]

Radon concentrations in samples determined using the formula [20]

$$C_S = \lambda_{Rn} C_{Rn} HT[l]^{-1} \quad (2)$$

where C_{Rn} is the air space radon concentration (Bq/m^3), C_S is the samples radon concentration (Bq/m^3), and λ_{Rn} is the radon decay constant (0.1814 day^{-1}), T stands for exposure time (60 days), H is for height of air gap in the plastic can (7 cm), and l stands for sample thickness (3 cm)

The uranium contents were calculated from the secular activity equilibrium of uranium and its daughters and the concentration of radon measured with the CR-39 detector. The activity of radon A_{Rn} in the sample may be calculated thanks to the correlation between C_{Rn} and the amount of radon in the sample [21].

$$A_{Rn} = C_{Rn}V \quad (3)$$

The volume of samples is ($V=\pi r^2 L$) $=115.4\times10^{-6}$ m^3, its thickness is 0.03 m, and its radon dosimeter radius is 0.035 m.

$$\lambda_{Rn}N_{Rn} = A_{Rn} \quad (4)$$

The equation of the equilibrium of uranium with its daughter (the uranium activity equals the radon activity) was used to compute the number of atoms of uranium (N_U) in the samples [22].

$$\lambda_U N_U = \lambda_{Rn} N_{Rn} \quad (5)$$

In this case, the uranium decay constant is λ_U (=$4.883\times10^{-18}s^{-1}$). The uranium atom number N_U was then used to compute the uranium weight in samples using the equation

$$W_U = \frac{N_U a_U}{N_{avo.}} \quad (6)$$

where W_U is measured in micrograms (µg), N_{avo} (6.02×10^{23} atom/Mol) is the number of Avogadro, and a_U is the uranium mass number 238. Uranium content is determined by [23]

$$C_U = \frac{W_U}{W_S} \quad (7)$$

Here, C_U represents the uranium concentration in (µg/g or ppm) units, and W_S equal to 125g

Uranium activity concentration is determined in unit of Bq/kg, in the form

$$Ac = \lambda_U N_{avo.}[At_U]^{-1} C_U \quad (8)$$

3. Results and Discussion

The study's average value of five farms' samples are listed in table (1). That includes the concentration of radon in samples C_{Rn} in units of Bq.m^{-3}, uranium concentrations in the samples C_U in ppm, and the uranium concentrations in the samples C_U in µg/kg and uranium activity concentration A_C in Bq/kg (Fig. 2).

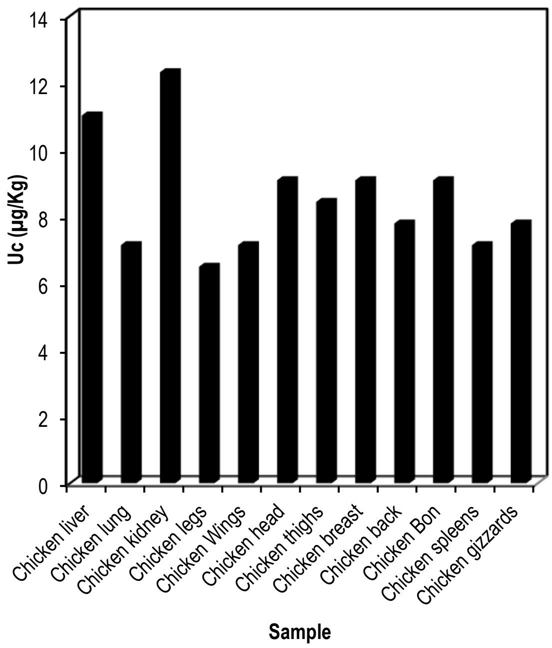

Fig. (2) Uranium concentrations (µg/kg) in the samples

The uranium content of chicken liver and kidney is higher than that of other chicken organs were the values are 12.312, and 11.0165 µg/kg respectively. Radionuclides from consuming water and other inorganic additives could be the cause of this. The chicken legs' low level of uranium content its value was 6.480 µg/kg. The mean uranium activity

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concentrations value is 1.0529 Bq/kg which it's below the world average of 35 Bq/kg [12]. Uranium can be readily absorbed by plants that are also used to raise chickens. Plant absorption is more influenced by the concentration of radionuclides in soil solutions than by their total concentrations [24]. The industrial methods used to make feeds and other human activities may be the cause of the high concentration of uranium found in feeds [25]. The findings demonstrated that eating chicken posed no dangers in the area under investigation.

4. Conclusion

Measuring uranium activity and concentration in chicken meat, bone, and other sections has been done. All of the samples were safe for ingestion by humans since their uranium activity contents were below the global average limit. According to the findings, eating chicken poses no dangers in the area under investigation.

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Table (1) The radon concentrations, uranium concentrations in ppm, and in µg/Kg.

No	Sample	C_{Rn} (Bq.m^{-3})	C_U (ppm)	C_U (µg/Kg)	A_C BqKg^{-1}
S1	Chicken liver	58.04524	0.011017	11.01656	1.360546
S2	Chicken lung	37.55869	0.007128	7.128365	0.880353
S3	Chicken kidney	64.87409	0.012313	12.31263	1.52061
S4	Chicken legs	34.14426	0.00648	6.480332	0.800321
S5	Chicken Wings	37.55869	0.007128	7.128365	0.880353
S6	Chicken head	47.80196	0.009072	9.072464	1.120449
S7	Chicken thighs	44.38754	0.008424	8.424431	1.040417
S8	Chicken breast	47.80196	0.009072	9.072464	1.120449
S9	Chicken back	40.97311	0.007776	7.776398	0.960385
S10	Chicken Bon	47.80196	0.009072	9.072464	1.120449
S11	Chicken spleens	37.55869	0.007128	7.128365	0.880353
S12	Chicken gizzards	40.97311	0.007776	7.776398	0.960385
	Min	34.14426	0.00648	6.480332	0.800321
	Max	64.87409	0.012313	12.31263	1.52061
	Mean	**44. 9565**	**0.0085324**	**8.53243**	**1.05291**

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