Iranian Journal of Medical Physics

ijmp.mums.ac.ir

Use of LR-115 Detector to Measure Radon Concentrations in Milk and Tea Samples Collected From Misan Markets in Iraq

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ARTICLE INFO

Article type:
Original Article

Article history:
Received: Apr 25, 2018
Accepted: Feb 07, 2019

Keywords:
Iraq
LR-115 Detector
Milk
Misan Markets
Radon
Tea

ABSTRACT

Introduction: Radioactive material is always present in the environment, and the largest contribution to the inhalation exposure comes from the short half-life decay products of radon. Accordingly, the concentrations of radon were measured in the milk and tea samples collected from Misan markets in Iraq.
Material and Methods: A total of 20 samples were taken to the laboratory in the School of Physics for sample preparation and then determined using LR-115 detector.
Results: The concentrations of radon measured in milk samples were observed to vary from 32.0 to 180.4 Bq/ m^3 in Celia 1 and Primer samples, respectively, with a mean value of 109.92 Bq/ m^3. However, the obtained results of radon concentration in the tea samples were noticed to vary from 40.0 Bq to 220.0 Bq/ m^3 in aeroplane and appeared samples, respectively, with a mean value of 158.64 Bq/ m^3. The radon concentration in the tea samples was higher than that in the milk samples. The result showed the radon concentration varied according to different kinds of samples depending on the source of samples.
Conclusion: The concentrations were below than the action levels of 200-600 Bq/ m^3 as recommended by the International Commission on Radiological Protection. According to the results, the collected samples did not pose any major threats.

► *Please cite this article as:*
Abdul Hussein AM, Shinen M.H, Aswood M. Use of LR-115 Detector to Measure Radon Concentrations in Milk and Tea Samples Collected From Misan Markets in Iraq. Iran J Med Phys 2019; 16: 319-322. 10.22038/ijmp.2019.31109.1365.

Introduction

The concentration of naturally occurring radionuclides in sustenance is changed generally due to contrasting foundation levels, atmosphere, and agricultural conditions that prevail. The largest contribution to the inhalation exposure comes from the short half-life decay products of radon (^{222}Rn) [1]. The ^{222}Rn is a naturally occurring colorless, odorless, tasteless inert gas, which is indistinct to the human's sense. It is delivered persistently from the rot of normally happening radionuclides, such as Uranium-238 (^{238}U), Uranium-235(^{235}U), and Thorium-232(^{232}Th). Uranium is a naturally occurring component present in practically all minerals, sand, vegetables, and soil. The isotope of ^{222}Rn, delivered from the decay of ^{238}U, is the principal source (roughly 55%) of inside radiation presentation to human life [2, 3]. Radon gas escapes easily from the ground into the air and disintegrates through short-lived decay products called radon daughter or radon progeny. It has a half-life of 3.82 days and decays by alpha ejection, and the alphas energy is 5.5 MeV [1-4]. There are a few essential pathways for the transfer of radionuclides to eating routine of people. The mainly ways of radon to causes the dose through food, water and medicine. Due to their quality in soil and phosphate composts, primordial radionuclides and their progeny are transferred by the food chain to the human body [5]. It is important to measure the radionuclide substance of food and water samples to evaluate potential radiation doses and assess the consumers exposed to radiation. The most imperative and overwhelming supporters of the inward breathing portion are the decay results of radon. Radon and its decay items that are noticeable all around structure the primary common sources of irradiation in human. Radon concentrations are higher indoors, yet there is also a considerable focus outside. Other than influencing general society, it is in charge of numerous malignant growths passing among uranium diggers [1]. The estimations of natural radioactivity in ecological components have been conducted in various nations to build up standard information from the natural radiation levels [3-9]. The objective of this study was to measure the radon concentrations in the milk and tea samples collected from Misan markets in Iraq.

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Materials and Methods

LR-115 Detectors

The LR-115 detectors utilized in the present assessment were created by DOSIRAD in France. The LR-115 comprises a functioning layer of red cellulose nitrate on a 100 µm clear polyester base substrate. The LR-115 films are known to be unaffected by electrons or by radiations in the electromagnetic spectrum, such as gamma rays, X-rays or infrared radiations visible light, and are, therefore, to be handled without risk where such radiations are present as shown in Figure 1. The LR-115 detectors cut to the size of 1.5 cm x 1.5 cm were used to measure the concentration of radon [10].

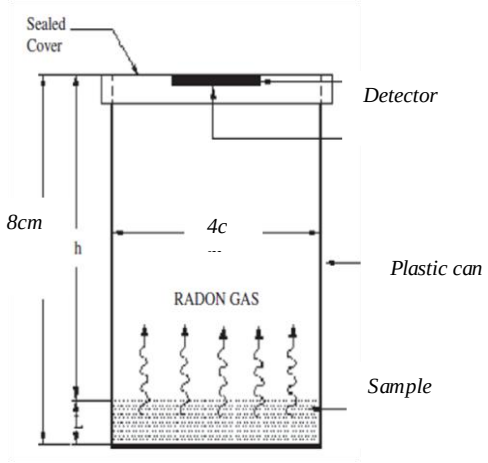


Figure 1. Experimental can for radon measurement

Sampling and Sample Preparation

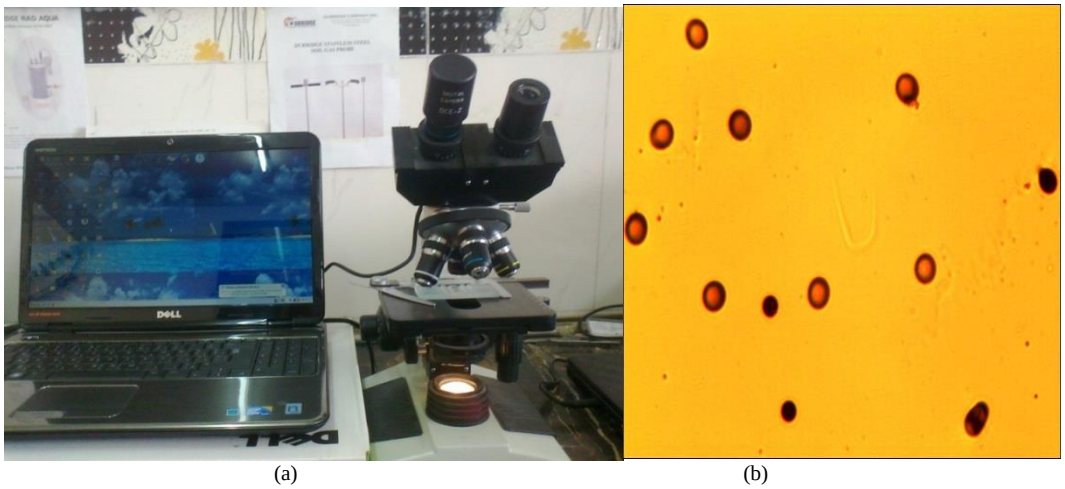
A total of 20 milk and tea samples were collected from Misan markets in Iraq. Each sample was reported as 80 gm. The samples were dried at 50 °C for 10 min to ensure that the moisture was completely evaporated. The tea samples were ground, homogenized, and sieved by a 2 mm mesh and then stored.

Experimental Procedure of LR-115

The milk and tea samples were exposed to LR-115 detector for 2 months. The LR-115 detectors were removed from the can and then etched with the optimum condition in a (2.5 N) sodium hydroxide solution for 120 min at 60 °C with the accuracy of ± 0.1°C for 2 h. After etching, the detectors were washed in distilled water and then dipped for a few sec in 3% acetic acid solution. After that, the detectors were washed again and allowed to be dried in the air. The number of tracks in 50 fields was scanned for each detector using an Olympus optical microscope made from China with a magnification of 40 X, and a webcam was connected to a computer to count the number of tracks per 0.05 cm^2 in each detector as shown in figures 2 a and 2 b. To compute the concentration of radon, the equation was used as it follows: [10, 11]

$$Q = \frac{\sigma \times h \times A}{\delta \times \tau \times m} \quad (1)$$

Where Q is the effective radon content of the sample, $\boldsymbol{\sigma}$ is the number of tracks in LR-115 detector, $\boldsymbol{\tau}$ is the exposure time, h is the distance between the detector and top of the sample in m, A is the area of the can in m^2, and δ is the detection efficiency. The calibration of LR-115 was measured using a radon chamber designed in the medical physics laboratory at the Department of Physics. The chamber was cubic in shape and was made up of Polymethyl methacrylate with dimensions of $50 \times 50 \times 50$ cm^3. A radon monitor (model: US 1023, made from USA), the cans used to put LR-115 detector, and a radium source ($5\ \mu$Ci) to generate radon gas were placed inside the chamber. The LR-115 pieces were placed inside the cans made up of polyvinyl chloride. All LR-115 detectors were kept for one month and then etched with the optimum condition as mentioned above to measure the radon concentration.



(a) (b)

Figure 2. a) Computer connected to optical microscope; b) scanning of alpha track density

Results

The measured values of radon concentration in the milk and tea samples collected from the Misan market are shown in tables 1 and 2. Table 1 tabulates the values of radon concentration that were measured using LR-115 in the milk samples. Theses concentrations varied from 32.0 to 180.4 Bq/ m^3 in Celia 1 (Iraq) and Primer (Ireland) samples, respectively, with a mean value of 109.92 Bq/ m^3. Table 2 shows the results of radon concentrations in tea samples using LR-115. The results of radon concentration using LR-115 in tea samples were observed to vary from 40.0 to 220.0 Bq/ m^3 in aeroplane (Sri Lanka) samples and appeared (Sri Lanka) samples, respectively, with a mean value of 158.64 Bq/ m^3.

Table 1. Radon concentration of milk samples collected from Misan markets

Samples	Product name	Country of product	Radon-222 (Bq/ m^3)
M1	Nactalial	France	49.2
M2	Guigoz1	Philippine	128.8
M3	Dielac 2	New Zealand	104.8
M4	Guigoz 2	Philippine	140.0
M5	Primer	Ireland	180.4
M6	Leryl	France	120.0
M7	Celia 2	France	124.0
M8	Celia 1	Iraq	32.0
M9	Pediasure Complete	Holland	92.0
M10	Novalac AC_2	France	128.0
Mean			109.92

Table 2. Radon concentration of tea samples collected from Misan markets

Samples	Product name	Country of product	Radon-222 (Bq/ m^3)
T1	Du dkaz	Sri Lanka	162.0
T2	Aeroplane	Sri Lanka	40.0
T3	Ahmed	London	80.0
T4	Samar kand	Sri Lanka	128.0
T5	Grape	Sri Lanka	108.0
T6	Farmer	Serilanka	204.0
T7	Mahmud	London	200.0
T8	Jehan	Sri Lanka	128.0
T9	Appeared	Sri Lanka	220.0
T10	Al otor gold	Sri Lanka	188.4
Mean			158.64

Discussion

The differences could be due to the variation of the country product and natural environment in these countries. These concentrations were below the action levels of 200-600 Bq/ m^3 as recommended by the International Commission on Radiological Protection (ICRP) [12]. The results of the radon concentration of tea samples were higher than those of milk samples maybe because the radionuclides were transferred directly from the soil. On the other hand, the lower and higher concentrations of tea samples were detected in the same country indicating that the concentration depends on the content of the soil. According to the obtained results, the studied samples did not pose any health risks. Moreover, the mean values of radon concentration in the milk and tea samples are a little high; however, it is not harmful to human health [10, 13, and 14].

Conclusion

The radon concentrations in 20 samples of milk and tea collected from Misan markets in Iraq were measured using LR-115 detector. The mean value of measured radon concentrations in milk samples was 109.92 Bq/ m^3 while the mean value of radon concentrations in tea samples was 158.64 Bq/ m^3. The results of the radon concentrations in tea samples were higher than those of milk samples. On the other hand, the lower and higher radon concentrations in tea samples were observed in the same country. The obtained result revealed that radon concentrations varied according to different kinds of samples depending on the source of samples. These concentrations were below the action levels of 200-600 Bq/ m^3 as recommended by the ICRP. According to the findings, the studied samples did not pose any health risks.

Acknowledgment

The authors are thankful to the College of Basic Education in Misan University for providing the necessary facilities to carry out the present project.

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