Journal of Environmental Analytical Chemistry
ISSN: 2380-2391

Al-Hamidawi, J Environ Anal Chem 2015, 2:4
DOI: 10.4172/2380-2391.1000147

Research article Open Access

NORM in Instant Noodles (Indomie) Sold in Iraq

Ali Abid Abojassim Al-Hamidawi*

University of Kufa, Faculty of Science, Department of Physics, Al-Najaf, Kufa, Najaf, Iraq

Abstract

The Radioactivity is invisible, tasteless and not mentioned on food labels, therefore it must be measured the Radionuclides levels in all samples food, we selected the important food that it is widely used in world Instant Noodles. Natural Radioactivity and Some Radiological Parameters of 13 instant noodles samples that available in Iraq supermarkets was determined using Gamma-ray Spectroscopy method. The results showed the range of specific activity for Ra-226 from (2.382 ± 1.128) Bq/kg to (31.918 ± 3.374) Bq/kg with an average (14.98231) Bq/kg, for Th-232 from (1.509 ± 0.297) Bq/kg to (9.269 ± 0.716) Bq/kg with an average (3.4421538) Bq/kg and K-40 from (113.069 ± 6.854) Bq/ kg to (392.453 ± 8.482) Bq/kg with an average (234.9235) Bq/kg, while the average results of Radium equivalent activity and Internal hazard indices were (37.99370015 Bq/kg and 0.143116) respectively. All specific activity (Ra-226, Th-232 and K-40) investigated in the noodle samples occurred within the threshold limit of UNSECR, (2000) standard (35, 30 and 400) Bq/kg, also Radium equivalent activity and Internal hazard indices were lower than the worldwide average (370 Bq/kg and 1) respectively. All the samples of fast noodles (Indomie) that are available in the Iraqi market are edible for all people, but caution should be taken for accumulation over the time of this natural radioactivity especially in samples where they appeared near the threshold limit amount.

Keywords: Natural radioactivity; Radiological parameters in food; Food in Iraq markets and instant noodles

Introduction

Natural Radioactivity elements are distributed everywhere in the environment with different concentrations. Their concentrations depend on the local geological condition and they vary from one place to another. It is necessary to monitor the release of radioactivity into the environment in order to provide an appropriate protection for humans [1]. Radionuclides in soil are absorbed by plants and will be available for further redistribution within food chains. These plants may be involved directly in human food [2]. Much work is reported on radioactive food contamination in the environment and its transfer or pathway mechanism to plants, animals and human population [3]. Ingestion of natural radionuclides depends on the consumption rate of food, water and the radionuclide concentrations. Naturally occurring radio nuclides enter the human body mainly by ingestion of primordial radio nuclides and their progeny ^{40}K, ^{238}U and ^{232}Th series. The ingested radio nuclides may be concentrated in certain parts of the body, for example ^{40}K is accumulated in muscles, ^{238}U is in human kidney and lungs, and ^{232}Th is in liver and skeleton tissue [4]. In Iraq, neither surveys of radioactivity in Instant Noodles were carried out nor for concentration of natural and anthropogenic radioisotopes. Therefore, the establishment of radioisotope concentrations will prove meaningful information that contribute to realize the population exposure and to the setting up of original base data, IAEA [5]. Moreover, numerous studies were conducted worldwide to investigate natural radionuclides in consumed food at different parts of the world [6-9]. Instant noodles played a pivotal role in addressing food issues, especially when the world population is anticipated to reach 10 billion by 2050 because it is cheap, tasty, storable and easy to cook [10], therefore studied Instant noodles in all scientific research such as natural radioactivity is important. Because Instant Noodles is popular among all ages, the current study focuses for investigating natural radioactive content in Instant Noodles. Study aim is to estimate radiation hazard indices from consumption of Instant Noodles among various types brand name in Iraqi markets.

Materials and Methods

Samples collection and preparation

Thirteen Instant Noodles samples were collected from some supermarkets that available in Iraq Markets. The collection period between December 2014 to February 2015. To ensure a comprehensive and a wide-spread representation, 13 different brands that originated from 5 different countries were selected (Table 1). Enough quantity of food samples (Instant Noodles) were collected for the analysis and each sample underwent a pre-treatment that consisted of powdering. This step was crucial for achieving a homogeneous state for the sample. Because Instant Noodles come dried, the samples did not undergo any drying process.

Radioactivity measurements

Radioactivity counting: Gamma-ray spectrometer equipment's is used. It is consists of scintillation detector NaI(Tl) of ("3×3") crystal dimension (Model No. 802 series, Canberra Inc.), supplied by (Alpha Spectra, Inc.-12I12/3), coupled with a multi-channel analyzer (MCA) (ORTEC - Digit Base, Model No. 1104) with range of 4096 channel joined with ADC (Analog to Digital Convertor) unit, through interface. Resolution value of the detector is about 7.9% for 0.662 MeV of a ^{137}Cs standard source; therefore it is capable of distinguishing the gamma ray energies considered during these measurements. The detector in this study was calibrated using a set of standard γ-ray 1-μCi active ^{137}Cs, ^{60}Co, ^{54}Mn and ^{22}Na sources. Moreover, it was shielded by a cylindrical lead shield in order to achieve the lowest background level. The relative efficiency for each of the peaks can be calculated with the mentioned energy depending on N_p (net peak area (count/ sec) at E_γ), N_p (net peak area (count/ sec) at E_γ), I_γ (intensity of emitted gamma ray (%)) and A(activity of standard source in (Bq)) by the following equation [11]:

$$Eff\,(\%) = \frac{N_p}{1_\gamma T_o A} \times 100\,\% \quad (1)$$

The samples of Instant Noodles were placed symmetrically on top of the detector and counting for each sample was done for a period of 5 hr (18,000 s). The net area counts under the photo peaks for each radionuclide that was analyzed using the ORTEC Maestro-32 data from the memory of the MCA which subtracts counts due to back-ground

***Corresponding author:** Ali Abid Abojassim Al-Hamidawi, University of Kufa, Faculty of Science, Department of Physics, Al-Najaf, Kufa, Najaf, Iraq, Tel: 964033 340952; E-mail: ali.alhameedawi@uokufa.edu.iq

Received June 09, 2015; **Accepted** July 07, 2015; **Published** July 14, 2015

Citation: Al-Hamidawi AAA (2015) NORM in Instant Noodles (Indomie) Sold in Iraq. J Environ Anal Chem 2: 147. doi:10.4172/2380-2391.1000147

No.	Sample Code	Sample Brand	Made Produce
1	S1	Indomie- Curry	SAUDI ARABIA
2	S2	Indomie-Special Chicken Flavor	SAUDI ARABIA
3	S3	Superman-Vegetables Flavor	SAUDI ARABIA
4	S4	Indomie-:Beef Flavor	SAUDI ARABIA
5	S5	Superman-Chicken Flavor	SAUDI ARABIA
6	S6	Indomie -Tomato Flavor	SAUDI ARABIA
7	S7	Chicken Flavor	UNITED ARAB EMIRATES
8	S8	Chicken with Onions	UNITED ARAB EMIRATES
9	S9	Vegetables Flavor	UNITED ARAB EMIRATES
10	S10	Vegetables Flavor	China
11	S11	Chicken Flavor	China
12	S12	Noodle- Vegetables Flavor	Italian
13	S13	Cup noodles (Pop Mie)	Indonesia

Table 1: Samples investigated in this study.

effects from the total area. The Radium-226 and Thorium-232 activities were determined indirectly through the secular equilibrium with their decay products. NaI(Tl) detector was made basing on the fact that it has a poor resolution. Hence, the peaks of interest to be considered would be sufficiently discriminated and intense. The activity of ^{226}Ra was estimated by the gamma transition lines of ^{214}Bi (1.760 MeV), while the activity of ^{232}Th was determined using gamma transition lines of ^{208}Tl (2.614 MeV) and the activity of ^{40}K was determined directly from the peak areas at 1.460 MeV. These peaks are clean, reasonably and strongly with very low continuum.

Radioactivity determination: Specific Activity of natural radioactivity in the Instant Noodles samples was computed by the net area count after background corrections in each photo peak, using the expression [12-14]:

$$C\left(B_q \big/ K_g\right) = \frac{C_n}{\varepsilon 1_\gamma M_s} \quad (2)$$

Where:

C is the Specific activity of the radionuclide in the sample.

C_n is the count rate under each photo peak due to each radio nuclides.

ε is the detector efficiency of the specific gamma ray.

I_γ is the absolute transition probability of the specific gamma ray.

M_s is the sample mass in (kg).

Calculations of radiological parameters: To arrive at a safe conclusion on the health impact of an environment, it is important to assess the gamma radiation hazards to human associated with the food used for eating of Instant Noodles. This is done by calculating the different radiation hazard indices. Radium equivalent activity can be defined on the basis of the preliminary estimation of the quantities of these radionuclides releasing the same gamma ray dose (^{226}Ra, ^{232}Th, and ^{40}K). Consequently, the following Radium Equivalent Activity (Ra_{eq}) of a sample in (Bq/kg) can be evaluated as [15]:

$$Ra_{eq} = C_{Ra} + 1.43\,C_{Th} + 0.07\,C_k \quad (3)$$

where C_{Ra}, C_{Th}, and C_k are the activity concentrations of ^{226}Ra, ^{232}Th, and ^{40}K in Bq/kg, respectively. Ra_{eq} activity has been assumed as 370 Bq/kg (10 pCi/g) ^{226}Ra, 259 Bq/kg (7 pCi/g) ^{232}Th and 4810 Bq/kg (130 pCi/g) ^{40}K provide the same gamma ray doses. Widely hazard index used radon and its short-lived progeny are hazardous to the respiratory organs which is called the internal hazard index. The internal exposure to radon and its daughter progenies is quantified by the internal hazard index H_{in}, which is given by the equation [15]:

$$H_{in} = \frac{C_{Ra}}{185} + \frac{C_{Th}}{259} + \frac{C_k}{4810} \quad (4)$$

For the safe use of a material in the construction of dwellings, index H_{in} should be less than unity.

Results and Discussion

Table 2 shows the specific activity of ^{226}Ra, ^{232}Th, and ^{40}K of the collected Instant Noodles samples which is Sold in Iraq Supermarkets. The specific activity of radionuclide collected from samples under study from (2.382 ± 1.128) Bq/kg to (31.918 ± 3.374) Bq/kg for ^{226}Ra, (1.509 ± 0.297) Bq/kg to (9.269 ± 0.716) Bq/kg for ^{232}Th, and (113.069 ± 6.854) Bq/ kg to (392.453 ± 8.482) Bq/kg for ^{40}K. There is a variation in the specific activity of radionuclides in different Instant Noodles samples, for example (S11) which is China product has lowest ^{226}Ra concentration, while (S3) which is SAUDI ARABIA product has the maximum value, (S8) UNITED ARAB EMIRATES product has the lowest ^{232}Th concentration of maximum is (S3) SAUDI ARABIA product, and the lowest ^{40}K concentration is (S4) which is SAUDI ARABIA product and the maximum is (S2) also SAUDI ARABIA. The results show, (Figures 1-3) that the specific activity of ^{226}Ra, ^{232}Th and ^{40}K respectively in all Instant Noodles samples appeared lower than recommended limit of (UNSCEAR, 2000). From the specific activity of ^{226}Ra, ^{232}Th, and ^{40}K of Instant Noodles samples, the Ra_{eq} and internal radiation hazard is calculated and the results are in (Table 3). The Ra_{eq} is calculated and the value ranges from (15.189) Bq/kg to (67.629) Bq/kg, which is very much lower than the recommended safe limit (370 Bq/kg) by Organization for Economic Cooperation and Development [16]. Also we found the internal hazard index is ranges from (0.052) to (0.268). All the calculated values are lower than the recommended safe limit (1) by Organization for Economic Cooperation and Development [16]. Correlation is a statistical measure for finding the degree of relationship between two or more variables. (Figure 4) shows the correlation between Ra_{eq} and ^{226}Ra activity concentrations computed

No.	Sample Code	Specific Activity in Bq/kg		
		^{226}Ra	^{232}Th	^{40}K
1	S1	5.686 ± 2.031	5.822 ± 0.536	273.436 ± 7.734
2	S2	13.861 ±2.715	1.859 ± 0.255	392.453 ± 8.482
3	S3	31.918 ± 3.374	9.268 ± 0.716	291.67 ± 8.031
4	S4	17.693 ± 2.302	4.08 ± 0.531	113.068 ± 6.854
5	S5	4.165 ± 1.952	------	143.181 ± 7.472
6	S6	5.467 ± 1.852	3.599 ± 0.370	133.85 ± 7.727
7	S7	23.506 ± 2.460	2.353 ± 0.388	252.112 ± 7.806
8	S8	20.992 ± 2.388	1.509 ± 0.297	268.21 ± 7.602
9	S9	26.269 ± 2.101	3.258 ± 0.332	314.68 ± 7.797
10	S10	14.704 ± 1.944	2.361 ± 0.268	318.775 ± 7.21
11	S11	2.381 ± 1.128	1.742 ± 0.297	242.173 ± 7.300
12	S12	8.14 ± 1.447	4.785 ± 0.409	181.451 ± 4.052
13	S13	19.988 ± 2.336	4.112 ± 0.587	128.947 ± 7.850
Average		14.98231	3.4421538	234.9235

Table 2: Specific Activity of radionuclide in Instant Noodles samples.

No.	Sample Code	Radiological parameters	
		Raeq (Bq/kg)	Hin
1	S1	35.066032	0.110061
2	S2	46.738251	0.163693
3	S3	67.62983	0.268952
4	S4	32.233636	0.134898
5	S5	15.189937	0.052281
6	S6	20.92002	0.071275
7	S7	46.283414	0.188559
8	S8	43.80204	0.175057
9	S9	55.1583	0.219996
10	S10	42.625905	0.15487
11	S11	23.519381	0.069944
12	S12	28.954277	0.100199
13	S13	35.797079	0.150728
Average		37.99370015	0.143116

Table 3: Radiological parameters for Instant Noodles samples.

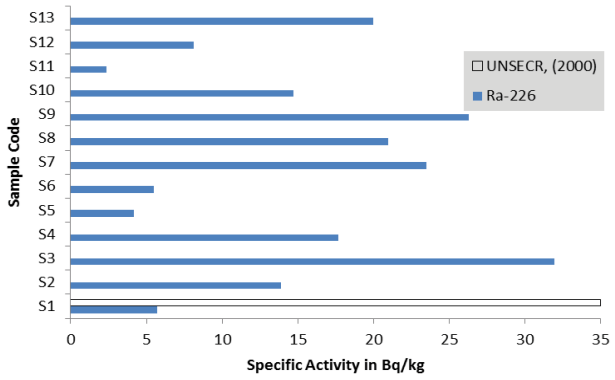

Figure 1: Relation between Specific Activity of ^{226}Ra with world of maximum allowed by UNSCER(2000).

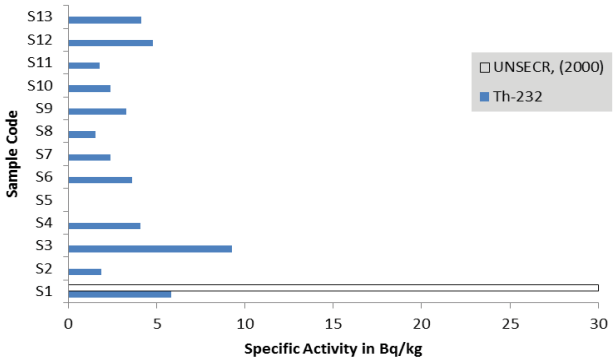

Figure 2: Relation between Specific Activity of ^{232}Th with world of maximum allowed by UNSCER(2000).

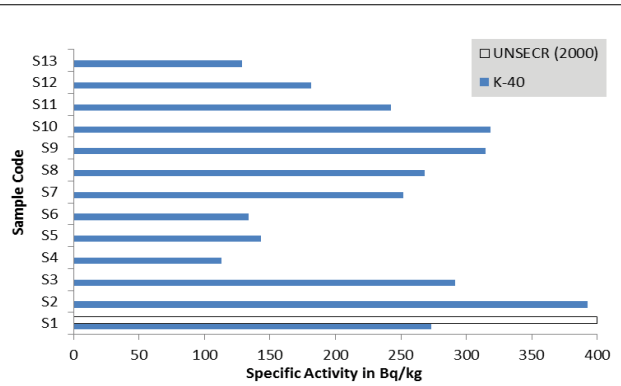

Figure 3: Relation between Specific Activity of ^{40}K with world of maximum allowed by UNSCER(2000).

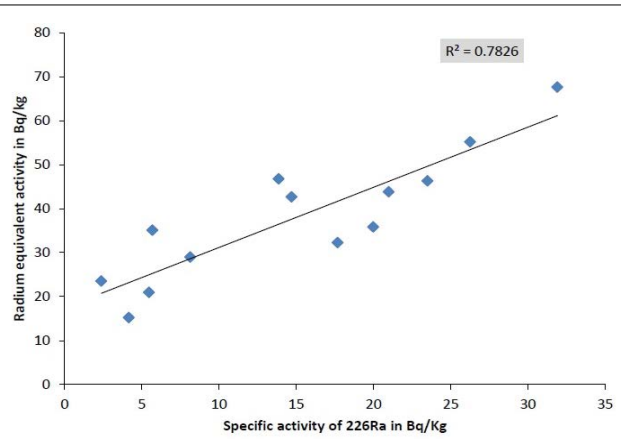

Figure 4: Correlation between radium equivalent activity and specific activity of ^{226}Ra.

from the Instant Noodles samples. A good correlation between Ra_{eq} and ^{226}Ra for the samples in all sampling places. The correlation coefficient between two quantity is R^2=0.7826. (Figure 5) shows the correlation between Hin and ^{226}Ra. A very good correlation between H_{in} and ^{226}Ra for all the sampling villages. The value of correlation coefficient is R^2 =0.9153. (Figure 6) shows the correlation between H_{in} and Ra_{eq}. A very good correlation between H_{in} and Ra_{eq}. The value of correlation coefficient is R^2=0.9644.

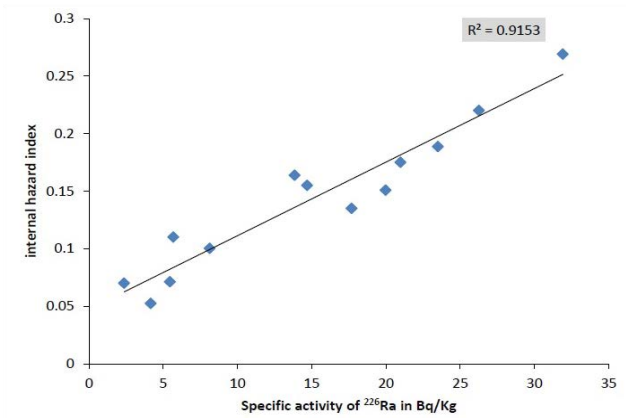

Figure 5: Correlation between internal hazard indices and specific activity of ^{226}Ra.

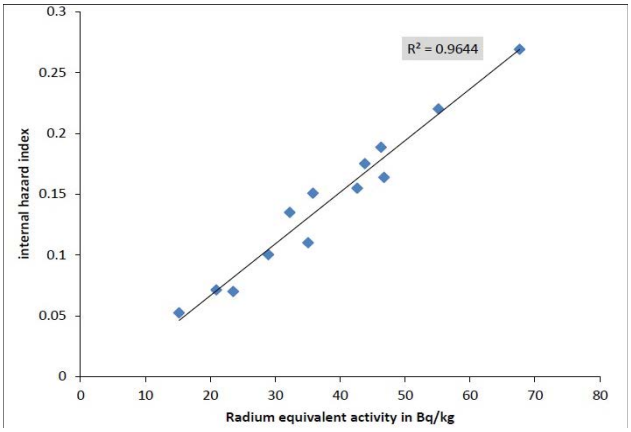

Figure 6: Correlation between internal hazard indices and radium equivalent.

Conclusions

^{226}Ra, ^{232}Th and ^{40}K have been measured in Instant Noodles samples that sold in Iraqi Markets using gamma-ray spectroscopy. The activity profiles of the radionuclides have clearly showed low activity for all samples under study. Some Radiological Parameters such as the Ra_{eq} and the H_{in} were calculated to assess the radiological hazards from eating of Instant Noodles. All the calculated parameters are lower than the recommended safe level. Thus, the result of this work showed that the natural radioactivity in each available noodles samples brands consumed in the Iraqi markets do not pose any health risks or effect of Radioactivity. But in the long term, accumulation of the radioactivity from some samples under study could lead to health issues [17-19].

Acknowledgments

I would like to acknowledge all the Department of Physics, nuclear laboratory, university of Kufa, for allowing us to use their instruments

References

1. Yang YX, Wu XM, Jiang ZY, Wang WX, Lu JG, et al. (2005) Radioactivity concentrations in soils of the Xiazhuang granite area, China. Appl Radiat Isot 63: 255-259.
2. Ciuffo LE, Belli M, Pasquale A, Menegon S, Velasco HR (2002) 137Cs and 40K soil-to-plant relationship in a seminatural grassland of the Giulia Alps, Italy. Sci Total Environ 295: 69-80.
3. Gaso MI, Segovia N, Cervantes ML, Herrera T, P-rerez-Silva E, et al. (2000) Radiation Protection Dosimetry 87: 213-216.
4. Adeniji AE, Alatise OO, Nwanya AC (2013) Radionuclide concentrations in some fruit juices produced and consumed in Lagos, Nigeria. American Journal of Environmental Protection 2: 37-41.
5. IAEA International Atomic Energy Agency (1989) measurement of Radiation in Food and the Environment. Technical Reports Series 295, Vinna.
6. Alrefae T, Nageswaran TN, Al-Shemali T (2012) Radioactivity of long lived gamma emitters in breakfast cereal consumed in Kuwait and estimates of annual effective doses. Iran J Radiat Res 10: 117-122.
7. Alrefae T, Tiruvachi N, Nageswaran (2013) Radioactivity of long lived gamma emitters in rice consumed in Kuwait. Journal of the Association of Arab Universities for Basic and Applied Sciences 13: p24-27.
8. Abojassim AA, Al-Gazaly HH, Kadhim SH, (2014) Estimated the radiation hazard indices and ingestion effective dose in wheat flour samples of Iraq markets. International Journal of Food Contamination 1: 1-5.
9. Alrefae T, Nageswaran TN, Al-Shemali T, (2014) Radioactivity of long lived gamma emitters in canned seafood consumed in Kuwait. Journal of the Association of Arab Universities for Basic and Applied Sciences 15: p6.
10. Anonymous (2000) World instant noodles market. Food Australia 60: 242-243.
11. El-Taher A (2012) Assessment of natural radioactivity levels and radiation hazard for building materials used in Qassim area. Rom Journ Phys 57: 726-735.
12. Akinloye MK, Olomo JB (2000) The Measurement of the Natural Radioactivity in Some Tubers Cultivated in Farmlands within the Obafemi Awolowo University Ile- Ife, Nigeria. Nigerian Journal of Physics 12: 60-63.
13. Farai IP, Ademola JA (2001) Population dose due to building materials in Ibadan, Nigeria. Radiat Prot Dosimetry 95: 69-73.
14. Jibiri NN, Farai IP, Alausa SK (2007) Activity Concentration of ^{226}Ra, ^{228Th}, and ^{40}K in Different Food Crops from a High Background Radiation Area in Bitsichi, Jos Plateau, Nigeria. Radiat Environ Biophys 46: 53-59.
15. Beretka J, Matthew PJ (1985) Natural radioactivity of Australian building materials, industrial wastes and by-products. Health Phys 48: 87-95.
16. Organization for economic co-operation and Development (OECD) (1979) Exposure to radiation from the natural radioactivity in building materials. Report by a group experts of the OECD nuclear energy agency, Paris, France.
17. Al-Hamidawi AA, Al-Gazaly HH, Al-Alasadi LA, (2013) Determination of natural radiation contamination for some types of legumes available in the Iraqi markets. Advances in Applied Science Research 4: 245-250.
18. Hou G, Kruk M (1998) Asian Noodle Technology. Technical Bulletin 20:10. International Food Research Journal 20: 309-313.
19. Jibiri NN, Ajao AO (2005) Natural activities of 40K, 238U and 232Th in elephant grass (Pennisetum purpureum) in Ibadan metropolis, Nigeria. J Environ Radioact 78: 105-111.