Activity Concentrations of Natural Radionuclides in Different Brands of Instant Noodles Consumed in Nigeria and their Health Risk Assessment

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Abstract
12 brands of instant noodles produced and consumed by Nigerians were analyzed for both short-lived and long-lived elements, using Instrumental Neutron Activation Analytical (INAA) method, to determine the activity concentrations of natural radionuclides in them and, hence, assess their health risk to consumers. The range of activity concentrations of ^{40}K in the samples were between 199.57±4.78 Bq/Kg and 257.28±6.89 Bq/Kg with a mean/average value of 224.11 Bq/kg. The concentrations of ^{232}Th in the samples varies from 1.031±0.192 Bq/Kg to 1.813±0.311 Bq/Kg with an average value of 1.395 Bq/Kg. A very low value of activity concentrations of ^{238}U was recorded in 4 out of 12 samples used for this study. The least and highest activity concentrations of ^{238}U were 0.210±0.099 Bq/Kg and 0.617±0.222 Bq/Kg respectively, with a mean of 0.153 Bq/Kg. The activity concentration of radionuclide elements detected in the samples are within the threshold limit/standard of UNSCEAR, (2000): 400 Bq/Kg (^{40}K), 30 Bq/Kg (^{232}Th) and 20 Bq/Kg (^{226}Ra). However, a steady increase in value of committed effective dose from 1.83 µSv yr^{-1} in 2016 to 2.46 µSv yr^{-1} in 2020 was recorded due to increase in consumption of noodles in Nigeria. Committed effective dose gives the rate of exposure of individuals to radionuclides as a result of consumption of noodles alone. It represents about 0.845% of the world average of 290µSv.yr^{-1} (UNSCEAR, 2000) and hence poses no health risk to consumers at the moment. Restraint should, therefore, be exercise to minimize the quantity of Instant noodles consumed to reduce exposure to natural radionuclides and avoid challenges associated with overtime accumulation of these radionuclides in the organs of the body.

Keywords: Activity concentration, Natural radionuclides, Instant noodles, Nigeria Health risk.

Introduction

The existence of Naturally Occurring Radionuclide Materials (NORMS), in our environments, is as old as the creation of the universe and/or the world itself. This is because all existing literature about NORMS reiterated the fact that they are left over from when the world and universe were created. Even human bodies contain NORMs because humans are products of their environment. Humans are subjected to NORMs on daily basis because of radiations from the environment we live, air we breathe, water we drink and food we eat. The exposures of humans to these natural sources could be both internal and external. Ingestion exposure dose mostly results from Uranium (^{238}U) and Thorium (^{232}Th) radionuclides series and Potassium-40 (^{40}K) in drinking water, vegetables, and foodstuff. The daily ingestion of

^{238}U and ^{232}Th has been reported to be 1.9 mg and 3 mg respectively for ICRP Reference Man (Lyengar et al., 2004) whereas proposed UNSCEAR values for the entire world (global average) populations are 15.6mBq (1.3 mg) for ^{238}U and 4.6mBq (1.1 mg) for ^{232}Th (UNSCEAR, 2000). Thorium accumulates in human lungs, liver and skeleton tissues, Uranium accumulates in lungs and kidneys and potassium accumulates in muscles. Depositions of large quantities of these radionuclides in particular organs produce radiation damage and biochemical and morphological changes (Akhter *et al.*, 2007; Adeniji *et al.*, 2013). The potential damage from an absorbed dose depends on the type of radiation, amount of exposure and the sensitivity of different tissues and organs. At higher doses, radiation can impair the functioning of tissues and organs as well as produce acute effects such as skin redness, hair loss, radiation burns or acute radiation syndrome. If radiation dose is low but delivered over a long period of time, the risk is substantially lower, however, there is still a risk of long-term effects such as cancer which may appear years later after the exposure.

Instant noodles, also known as instant ramen, are noodles sold in a precooked and dried block with flavoring powder and/or seasoning oil. The flavoring is usually in a separate packet, although in the case of cup noodles, the flavoring is often loose in the cup. Instant noodles were invented by Momofuku Ando of Nissin Foods in Japan and launched in 1958 under the brand name Chikin Ramen (Wallace, 2007; BBC News, 2000). The history of instant noodles in China dated back to many centuries, and there seems evidence that a noodle that is boiled, then fried and served in a soup, similar to Yi noodle, dated to ancient China (Zhang *et. al.*, 2016). The main ingredients in instant noodles are (wheat) flour, starch, water, salt and/or a salt substitute known as *kansui*, a type of alkaline mineral water containing sodium carbonate and usually potassium carbonate, as well as sometimes a small amount of phosphoric acid (Fu, 2007). Specific type of noodles could be made from a mix of wheat flour and other flour, such as buckwheat or rice. There are variations to the ingredients used in preparations of noodles depending on the country of origin and consumers taste in terms of the salt and flour content.

Instant noodles was introduced into Nigeria in 1988 and are now being eaten in majority of the households across the country. By 2008, nine other brands of noodles had appeared in Nigeria market. According to the World Instant Noodle Association, Nigeria was the eleventh largest consumer of instant noodles in the world in 2019 (WINA, 2020). The global demand (consumption) for instant noodles is depicted in Table 1 below.

Purpose of the Study

The major purpose of the study was to determine the Activity Concentrations of Natural Radionuclides in Different Brands of Instant Noodles Consumed in Nigeria and their Health Risk Assessment. Specifically, the study was poised to:

a. reveal the Global demand for instant noodles (in billion servings)

b. ascertain the Average Individual Annual Intake of Instant noodles from 2016 – 2020 in Nigeria
c. determine the Concentrations of natural radionuclides in Instant noodle samples in parts per million (ppm)
d. determine the Activity concentrations of natural radionuclides in Instant noodle samples in Becquerel per Kilogram
e. ascertain the Dose estimation of natural radionuclides (^{40}K, ^{232}Th and ^{238}U) from 2016 – 2020 of consumers due to consumption of Instant noodles by Nigerians

Methodology

Different brands of noodles produced locally by different companies, and consumed by Nigerians were procured from major distributors of these companies across the country. The research design adopted by this study is Experimental. Each of the samples of the noodles was then taken to the preparatory laboratory of the Centre/Institute for Energy and Research Training (CERT) where they are grounded into powder form following International laid down procedures to avoid contamination of the samples. 8ml polythene vials were procured and sterilized in a mixture of distilled water (200ml) and trioxonitrate (V) acid (HNO_3) (100ml) for 24 hours. These vials were then dried using a solar drier or blower. The sterilized polythene vials were each weighed empty and weight noted before putting powder form of each of different brands of the noodles in separate vials and reweighed. Between 0.2500-0.3000g of each of the samples (biological) required were weighed, before the vials were blown and sealed. By the use of rabbit carriers, samples of Instant Noodles from different companies (together with the standards) were transferred into the Nigeria Research Reactor (NIRR-1) through a Pneumatic Transfer System which uses Pneumatic Pressure for irradiation. For the detection of short-lived radioactive elements, the samples were irradiated with thermal neutron flux of 2.5 x 10^{11} ncm^{-2}s^{-1} for five (5) minutes duration in the Reactor. However, for long-lived radionuclides, the samples were irradiated with thermal neutron flux of 5.0 x 10^{11}ncm^{-2}s^{-1} for six (6) hours. The whole of the Reactor system is equipped with the electronic timers which help in monitoring the exact irradiation and decay time. After irradiation, the samples were returned from the Reactor by Pneumatic Pressure through an ejector. The activity of the irradiated samples were allowed to decay/fall within the acceptable handling limit of about 30µSv.hr^{-1} which is well below the initial activity of the samples (in µSv.hr^{-1}) immediately after their removal from the Reactor. The first counting, which is normally for a period of 30 minutes, was carried out immediately after the acceptable handling limit was attained, usually after the samples had been allowed to cool for 72 hours. After the first counting, the samples were allowed to cool further for a period of 7 days before the second counting which lasted for one hour (60 minutes) was carried out. The samples were then taken to a detecting set-up for analysis, which consists of a High Purity Germanium (HPGe) detector connected to a PC-based Multi-Channel Analyzer (MCA) in a fixed sample to detector geometry. This is carried out by trained personnel of the Centre. The concentrations of different constituent elements in the samples were determined and analyzed using the Certified Values of Standard Reference Materials (SRM) 1515 Apple Leaves of QAQC of NIST (National Institute of Standard and Technology) USA.

Validation and Reliability of Results

Validation and reliability of the results of the analysis obtained was ensured through agreement between Standard Reference Materials (SRMs) for QAQC used in this research (SRM 1515) and the Certified Values of SRM 1515 Apple Leaves of QAQC of NIST (National Institute of Standard and Technology) USA.

Conversion Factors ppb U, ppb Th, ppm K to Bq/kg

The equations given below were used to convert from parts per billion (ppb) of Uranium and Thorium, and parts per million (ppm) of Potassium to Becquerel per kilogram (Bq/kg). The conversion factors for the primordial nuclides (IAEA, 1989) are given by:

(i) 1Bq of ^{238}U/kg = 81ppb U = 81 x 10^{-3}ppm U,
(ii) 1Bq of ^{232}Th/kg = 246ppbTh = 246 x 10^{-3}ppm Th, and
(iii) 1Bq of ^{40}K/kg = 32.3ppm K.

Dose Estimation

Ingestion dose occurring through the intake of radionuclides depends on the consumption rate of fruits, vegetables and foodstuff, and the concentration of the radionuclides involved. Ingestion dose is calculated using the following equation (ICRP 1994; 1996 and UNSCEAR 2000)

$$H_{Tr} = \sum (u^i C^i_r) g_{Tr}$$

Where: i is the foodstuff group; $\square^i$ and C^i_r are annual consumption rate (kg) and radionuclide activity concentration (Bq/kg); and, g_{Tr} is the dose conversion coefficient for r radionuclide in Sv/Bq.

The dose conversion coefficients (g_{Tr}) for ^{238}U, ^{232}Th, ^{40}K and ^{137}Cs radionuclides for adult members of the society/public are: 4.5 x 10^{-8}, 2.3 x 10^{-7}, 6.2 x 10^{-9} and 1.3 x 10^{-8} Sv/Bq respectively (ICRP 1994; 1996 and IAEA 2005).

Results

Table 1: Global demand for instant noodles (in billion servings).

Year / Country	2014	2015	2016	2017	2018	2019	2020
China	44.40	40.43	38.52	38.97	40.25	41.45	46.35
Indonesia	13.43	13.20	13.01	12.62	12.54	12.52	12.64
India	5.34	3.26	4.27	5.42	6.06	6.73	6.73
Japan	5.50	5.54	5.66	5.66	5.78	5.63	5.97

Vietnam	5.00	4.80	4.92	5.06	5,20	5.43	7.03
United States	4.28	4.08	4.10	4.13	4.40	4.63	5.05
Philippines	3.32	3.48	3.41	3.75	3.98	3.85	4.47
South Korea	3.59	3.65	3.83	3.74	3.82	3.90	4.13
Thailand	3.07	3.07	3.36	3.39	3.46	3.57	3.71
Brazil	2.37	2.37	2.35	2.23	2.37	2.45	2.72
Russia	1.94	1.84	1.57	1.78	1.85	1.91	2.00
Nigeria	1.52	1.54	1.65	1.76	1.82	1.92	2.46
Nepal	1.11	1.19	1.34	1.48	1.57	1.64	1.54
Malaysia	1.34	1.37	1.39	1.31	1.37	1.45	1.57
Mexico	0.90	0.85	0.89	0.96	1.18	1.17	1.16

Source: WINA, 2020 (*instantnoodles.org.)*

Table 2: Average Individual Annual Intake of Instant noodles from 2016 – 2020 in Nigeria**:**

Year	**Nigerian population (in millions)**	**Annual demands of noodles (in billion servings)**	**Mass/pack of Noodle samples (in grams)**	**Total annual consumption of noodles in Nigeria (in g)**	**Total annual consumption of noodles in Nigeria (in Kg)**	**Individual annual intake in Nigeria (in Kg)**
2016	185.96	1.65	120.0	1.980×10^{11}	1.980×10^{8}	1.065
2017	190.87	1.76	120.0	2.112×10^{11}	2.112×10^{8}	1.107
2018	195.88	1.82	120.0	2.184×10^{11}	2.184×10^{8}	1.115
2019	200.96	1.92	120.0	2.304×10^{11}	2.304×10^{8}	1.146
2020	206.14	2.46	120.0	2.952×10^{11}	2.952×10^{8}	1.432

Table 3: Concentrations of natural radionuclides in Instant noodles samples in parts per million (ppm)

S/No	**Sample code**	**Sample name**	**Concentrations in parts per million (ppm)**		
			^{40}K	**^{232}Th**	**^{238}U**
1.	SUP	SUPREME	6565±17	0.348±0.052	0.047±0.013
2.	MIN	minimie	7706±32	0.391±0.055	BDL
3.	GDP	Golden Penny	7592±30	0.446±0.066	BDL
4.	HNW	HONEYWELL	7797±21	0.299±0.050	BDL
5.	CHE	Cherie	7936±33	0.292±0.050	BDL
6.	MIM	MIMEE	7435±26	0.397±0.054	0.050±0.018
7.	JLY	JOLLY-JOLLY	6636±23	0.418±0.058	0.017±0.008
8.	TYT	Tasty Tom	8310±50	0.254±0.047	0.035±0.012
9.	IND-1	Indomie – CKN	6446±30	0.274±0.052	BDL
10.	IND-2	Indomie – ONC	6515±25	0.299±0.049	BDL

11.	IND-3	Indomie – CPS	6785±31	0.373±0.050	BDL
12.	IND-4	Indomie - OFN	7142±29	0.328±0.049	BDL
Average			**7238.75**	**0.343**	**0.0124**

Table 4: Activity concentrations, in Bq/Kg, of radionuclides in Instant noodle samples.

S/No	Sample code	Sample name	Activity concentrations in Bq/Kg		
			^{40}K	^{232}Th	^{238}U
1.	SUP	SUPREME	203.25±0.53	1.415±0.210	0.580±0.160
2.	MIN	minimie	238.58±0.99	1.591±0.223	BDL
3.	GDP	Golden Penny	235.05±0.93	1.813±0.311	BDL
4.	HNW	HONEYWELL	241.39±0.65	1.217±0.203	BDL
5.	CHE	Cherie	245.70±1.02	1.187±0.205	BDL
6.	MIM	MIMEE	230.20±0.80	1.615±0.22	0.617±0.222
7.	JLY	JOLLY-JOLLY	205.45±0.71	1.701±0.301	0.210±0.099
8.	TYT	Tasty Tom	257.28±1.55	1.031±0.192	0.432±0.148
9.	IND-1	Indomie - CKN	199.57±0.93	1.112±0.210	BDL
10.	IND-2	Indomie - ONC	201.70±0.77	1.214±0.201	BDL
11.	IND-3	Indomie – OFN	210.06±0.96	1.515±0.205	BDL
12.	IND-4	Indomie – CPP	221.11±0.90	1.333±0.201	BDL
Average			**224.11**	**1.395**	**0.153**

Table 5: Dose estimation of natural radionuclides (^{40}K, ^{232}Th and ^{238}U) in Instant noodles from 2016 to 2020 in Nigeria

Year	Annual Intake (kg)	Mean Activity Conc. (Bq/kg)			Activity Intake (Bq)			Committed Effective Dose (μSv.yr^{-1})
		^{40}K	^{232}Th	^{238}U	^{40}K	^{232}Th	^{238}U	
2016	1.065	224.11	1.395	0.153	238.677	1.486	0.1629	1.83
2017	1.107	224.11	1.395	0.153	248.090	1.544	0.1694	1.90
2018	1.115	224.11	1.395	0.153	249.883	1.555	0.1706	1.91
2019	1.146	224.11	1.395	0.153	256.830	1.599	0.1753	1.97
2020	1.432	224.11	1.395	0.153	320.926	1.998	0.2191	2.46

Discussion of Findings

Table 1 reveals the global demand for instant noodles by 15 countries with the highest consumption rate of instant ramen. China has been on top of the list from 2014 (with 44.40 billion servings) through 2020 (with 46.35 billion servings). Indonesia is next to China in demand and/or consumption of instant ramen with 13.43 billion servings in 2014, and 12.54 billion servings in 2020. From Table 1, five countries were below 2 billion servings of instant noodles in 2014; Russia (1.94), Nigeria (1.52), Nepal (1.11), Malaysia (1.34) and Mexico (0.90), only one country, Nigeria (2.40), has moved above 2 billion servings boundary by 2020. Between 2019 and 2020, about 0.54 billion (540 million) servings increase in consumption of noodles was recorded in Nigeria. This shows that instant noodles are fast becoming the favorite food of people in Nigeria. The exposure of individual to radiation through ingestion of various foods we eat need to be monitored, especially those that are fast becoming favorite of the people. The intake of radionuclides, due to noodles consumption, is gradually becoming one of the largest contributors of radiation doses received by the human body. Instant noodles are often criticized as unhealthy or junk food (Rombouts *et. al*., 2014). A single serving of instant noodles is high in carbohydrates, salt and fat, but low in protein, fiber, vitamins and essential minerals (Hope, 2001). Increased consumption of instant noodles has been associated with obesity and cardio-metabolic syndrome in South Korea, which has the highest per capital instant noodles consumption, 74.1 servings of instant noodles per person in 2014, worldwide. In view of this, it is important to establish databases of the concentration of long-lived radionuclides in noodles, which is fast becoming one of the most popular foods, to ensure that the radiation levels are within the specified safety limits. These databases could be useful as baseline values to estimate the radiation hazard indices from wheat flour and noodles among various brand names in Nigeria markets.

Table 2 shows the Average Intake of Instant noodles by individuals in Nigeria from 2016 – 2020. The mass of each pack of noodle samples (120 grams) was multiplied by Annual demands of noodles (in billion servings) and then divided by the population of Nigerians for each year from 2016 to 2020 to determine the average individual annual intake of Instant noodles. A steady increase, from Table 2, in Individual Annual Intake was recorded between 2016 and 2020. This translates to increase in exposure rate to natural radionuclides due to consumption of Instant noodles by Nigerians.

Table 3 shows the concentration of natural radionuclides in the samples of noodles analyzed in parts per million (ppm). The concentration of ^{40}K in all the samples is generally high compare to other natural radionuclides found in the samples. This is due to the fact that ^{40}K is the most abundant natural radionuclide present in food samples. It may be expected that soil characteristics favor the mobilization of potassium and its subsequent migration into different parts of the plant.

Table 4 shows the activity concentration, in Bq/Kg, of naturally occurring radionuclides: ^{40}K, ^{232}Th and ^{238}U in instant noodles produced and consumed in Nigeria. The concentration of ^{40}K in all the samples of the noodles is generally high compared to other natural radionuclides found in the samples. The highest concentration of ^{40}K was recorded in TYT (Tasty Tom) which was 257.28±6.89 Bq/Kg while the least concentration of 199.57±4.78 Bq/Kg was obtained in IND-1 (Chicken flavor). The mean concentration of ^{40}K in all the instant noodles is 224.11 Bq/Kg. This result is in agreement with the world range reported by Maud and O'Hara (1989) for ^{40}K concentration in food samples which is between 40 Bq/Kg and 240 Bq/Kg. The high concentration of ^{40}K is due to the fact that ^{40}K is a macronutrient and also that it is the most abundant natural radionuclide found in food samples. Its activity concentration varies from 50 Bq/Kg to 686 Bq/Kg depending on the nature of the sample. It may be expected that the soil characteristics favor mobilization of Potassium and its subsequent migration into plant (Wheat, a major component used in the production of the noodles). ^{232}Th was also detected in all the samples of the instant noodles, however, its concentration is generally low compare to that of ^{40}K. Unlike ^{40}K, ^{232}Th is not a macronutrient element but a radioactive element. The concentrations of ^{232}Th in the samples varies from 1.031±0.192 Bq/Kg in TYT (Tasty Tom) to 1.813±0.311 Bq/Kg in GDP (Golden Penny). The mean concentration of ^{232}Th in all the noodle samples is 1.395 Bq/Kg. The presence of ^{232}Th in the samples is largely due to the fact that it is one of the natural radionuclides found in the soil and that during the uptake of nutrients from the soil by plant, a little amount of ^{232}Th is also taken up by the plant together with other nutrients. Some of the element is either stored up in the leaves or seed or other parts of the plant. The activity concentration of ^{238}U in eight out of twelve instant noodle samples used in the study was below the detection limit (BDL) of the Neutron Activation Analytical (NAA) method used in the analysis of the samples. However, some (very little) amount of ^{238}U was detected in samples of SUP; MIM; JLY and TYT. The highest concentration of ^{238}U in the samples was recorded in MIM (MIMEE) which is 0.617±0.222 Bq/Kg while the lowest concentration of 0.210±0.099 Bq/Kg was detected in JLY (JOLLY-JOLLY). The mean concentration of ^{238}U in the samples is 0.153 Bq/Kg. The presence of ^{238}U in some of the noodle samples is that ^{238}U is also taken up with some of the nutrients in the soil during the plant growth and stored in different parts of the plant (Wheat).

Table 5 shows the committed effective dose of natural radionuclides in Instant noodles produced and consumed in Nigeria from 2016 to 2020. Committed effective dose is concern with the amount of natural radionuclides that consumers are exposed to consequent of consumption of noodles produced locally in Nigeria on yearly basis. The average annual intake for each of the year from 2016 to 2020 was multiplied by the mean activity concentrations of ^{40}K, ^{232}Th and ^{238}U of this study, to obtain the activity intake of each of the natural radionuclides detected in the samples. While the effective dose value for each year was obtained from the summation of the product of the activity intake, in Becquerel and the effective dose coefficients of each of the natural radionuclides respectively. A steady increase in value of committed effective dose from 1.83µSv.yr^{-1} in 2016 to 2.46µSv.yr^{-1}in 2020 was observed in Table 5. This is due to the fact that there is a corresponding steady increase in demand of instant noodles in Nigeria within the same period. Dose values obtained in this study fall within acceptable limit for public as widely reported in literature (Maud and O'Hara, 1989). In 2020 for instance, each individual is exposed to about 2.45µSv.yr^{-1} of natural radioactivity due to consumption of instant noodles alone. Though it is assumed that all Nigerians consumed noodles in that year. This value represent about 0.845% of the world average of 290µSv.yr^{-1} (UNSCEAR, 2000). Consumption of instant noodles, therefore, poses no serious health risk to consumers in Nigeria and, hence, public health.

Summary of the Findings

The mean activity concentrations of ^{40}K, ^{232}Th and ^{238}U, (224.11 Bq/Kg. 1.395 Bq/Kg and 0.153 Bq/Kg respectively) obtained in this study were lower than the values reported in similar studies carried out by Abojassim, (2015); Alshahir, (2016) but higher than values obtained by Yu & Mao, (1995). However, the values of activity concentrations recorded are within the threshold limit/standard of UNSCEAR, (2000): 400 Bq/Kg (^{40}K), 30 Bq/Kg (^{232}Th) and 20 Bq/Kg (^{226}Ra). A steady increase in demand for Instant noodles was recorded in Nigeria, from 1.52 billion servings in 2014 to 2.46 billion servings in 2020, which led to corresponding increase in exposure to natural radionuclides, due to ingestion of Instant noodles from 1.83 µSv.yr^{-1} in 2016 to 2.46 µSv.yr^{-1}in 2020. The values of committed effective dose obtained in this study are lower than one recorded in similar study by Olabimtan, (2015). A further increase in demand and consumption of Instant noodles imply a greater value of exposure to natural radionuclides by consumers. Though the committed effective dose value of 2.46 µSv.yr^{-1} poses no health risk to an average Nigerian at present but caution should be taken about the rate of consumption of noodles by consumers to avoid diseases or challenges associated with accumulation of natural radionuclides over a period of time.

Recommendations

As a result of findings of the study, it is, therefore, recommended that: consumers of Instant noodles should exercise restraint in the volume or amount of noodles consumed to avoid obesity, cardio metabolic syndrome and, more importantly, diseases associated with overtime accumulation of radionuclides in the body, and Wheat (a major component of Noodles) farmers should be discouraged from the use of phosphate fertilizers which contains high concentration of radionuclides (Al-Hamidawi, 2015; and Ahmad *et. al*., 2015) during wheat cultivation to lower the concentrations of radionuclides in wheat grain used in the production of Instant noodles.

Conclusions

Activity concentrations of natural radionuclides in different brands of instant noodles produced and consumed by Nigerians were determined using Neutron Activation Analysis (NAA). ^{40}K, being a macronutrient element, was detected in all the samples and its concentrations ranges from 199.57±4.78 Bq/Kg in Indomie-Chicken flavor to 257.28±6.89 Bq/Kg in Tasty Tom. ^{232}Th was also detected, though in low concentrations, in all the samples with its highest concentration of 1.813±0.311 Bq/Kg in Golden Penny while the least concentration of 1.031±0.192 Bq/Kg was recorded in Tasty Tom. The mean concentration of ^{232}Th in all the noodle samples was 1.395 Bq/Kg. ^{238}U was below the detection limit (BDL) of the analytical technique used in 8 out of 12 samples used for the study. However, a very low concentrations were recorded in 4 samples with the highest concentration of 0.617±0.222 Bq/Kg in MIMEE and lowest of 0.210±0.099 Bq/Kg in Jolly-Jolly. The highest value of committed effective dose of 2.46µSv.yr^{-1} was obtained for the year 2020. This represents a contribution of 0.845% of the world average value, which is 290µSv.yr^{-1}. Therefore, the exposure of consumers to natural radioactivity through ingestion of instant noodles is very minimal and no serious health risk is involved.

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