Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.2, No.6, 2012
www.iiste.org

Radioactivity in Some Food Crops from High Background Radiation Area on the Jos –Plateau, Nigeria

D.I.Jwanbot[1*], M.M. Izam[2] and G.G. Nyam[3]
1*. & 2. Department of physics, University of Jos, Nigeria.
3. Department of physics, University of Abuja, Nigeria.
* Email of corresponding Author: Jwanbot2009@yahoo.com

Abstract
The activity Concentration of ^{40}K, ^{226}Ra and ^{228}Th were determined in the food crops on the Jos Plateau using γ-ray spectrometry. The activity concentration of the natural radionuclide in the food crops lied between 12.36 ± 0.82 and 56.92 ± 8.84Bq/Kg for ^{40}K,(1.46 ± 0.05 to 10.42 ± 0.04) Bq/Kg for ^{226}Ra and from (1.53 ± 0.08 to 6.85 ± 0.42) Bq/Kg for ^{228}Th. These relativity high values for the activity concentrations maybe attributed to the series of tin mining activities that have taken place in these areas in the past decades. However, the values obtained suggest that the dose taken from intake of these radionuclides in the food crops is low and that harmful effects are not expected.
Keywords: Radionuclides, Activity concentration, Food crops, Mining ,Jos-Plateau.

1. Introduction

Many years of tin mining on the Jos- Plateau have left a legacy of polluted water supplies, impoverished agricultural land and soil having abnormal high levels of natural occurring radioactive elements Jibiri (2007). Terrestrial radiation varies from place to place depending upon the variation of radionuclide concentration in the soil. Areas where the natural background radiation is higher than normal are called high background radiation and some of these areas (Barkin Ladi, Kuru Jenta and Bisichi) are found on the Jos- Plateau.The earth contained varied levels of radioactivity due to chain delay of natural radionuclides ^{238}U and ^{228}Th and ^{40}K (Saleh et al 2007). Soil features, geological formations and human activities (such as mining) related to radiations and radioactivity are important factors enhancing the background levels of natural radiation (ColmeneroSujo, et al (2004)). Natural occurring radionuclides of ^{228}Th and ^{238}U have significant contributions in the ingestion dose and are present in the biotic system of plants, animals, soil, water and air. Distribution of radionuclides in different parts of the plant depends on the chemical characteristics and several parameters of the plants and soil (Shanthi, G. et al (2009)).

In this work, the activity concentration of the radionuclides ^{238}U, ^{228}Th and ^{40}K in food crops were determined. The work focused on some selected food crops (Yam, Cassava, Sweet Potatoes, Lyang kwan, Lettuce, Carrot, Green Pepper, Tomatoes, Okra, Cabbage, Water Melon and Vaat) commonly available and consumed on the Jos Plateau.

2. Materials and Method

In order to ascertain the radiological food safety of the population, different crops that constitute the major food nutritive requirements were collected across farmlands and vegetable gardens in the area under study. A total of twenty (20) food crops were collected emptied into a polythene bag; tied and labeled.

The food crop samples were first washed under running water and the in distilled water to remove all the attached sand and dust particles. The samples were weighed and dried in the oven at 140^{0}C for 48 hours. The concentration of gamma ray emitting radionuclides in all the samples was measured by using high efficiency 48mmx 48mm NaI detector. Assuming that the two primordial radionuclides ^{238}U and ^{228}Th were in secular equilibrium with their corresponding decay products, the ^{238}U and ^{228}Th activity concentration was calculated through 1764Kev of ^{214}Bi and 2614.5Kev of ^{208}Tl respectively (Shanthi, G. et al ,2009).

3. Results and Discussion

The activity concentration measurements in the food crops in the study areas are presented in table 1 and fig 1. Among the 20 food crops collected and analyzed, the activity concentration of ^{40}K varies between 12.36 ± 0.82 Bq/Kg (Irish potatoes) and 56.92 ± 8.84Bq/Kg (Spinach). The ^{226}Ra activity in food crops varies between 1.46 ±0.05Bq/Kg (Karkashe) and 10.42 ±0.04 Bq/Kg (Water Melon). The activity concentration in ^{228}Th ranged from 1.53 ± 0.08Bq/Kg (Garden egg) to 6.85 ± 0.42 Bq/Kg (Vaat).

The activity concentration of ^{40}K was more in fruits and vegetables when compared to tubers. The level of ^{40}K in Tomato was 32.37 ± 4.44 Bq/Kg, 28.24 ± 3.12 Bq/Kg for Green leaves and for cassava 17.97 ± 1.24 Bq/Kg. this result is in agreement with the world range which is from 40 to 240 Bq/Kg Man, L. and O' Hara (1989).

The results show that all vegetables predominantly absorb ^{40}K more than ^{226}Ra and ^{228}Th radionuclide. This is due to the fact that potassium is an essential element and plants do not have the capability of elemental isotopic differentiation thus ^{40}K is preferred to the other two radionuclides. Spinach absorbed the highest amount of ^{40}K concentration of 56.92 ± 8.84Bq/Kg followed by cucumber and cabbage with values of 51.34 ± 10.24Bq/Kg and 42.37 ± 5.88Bq/Kg respectively. Spinach and cucumber are leafy vegetables with broad leaves, having ^{40}K absorption points. That is through root uptake and from the leaves as a result of atmospheric deposit.

On the average, the vegetables preferred the absorption of thorium to radium, while the root crops relatively absorbed more thorium than radium. This is in agreement with the work of Holfman (1980). By induction the Jos Plateau is enriched in thorium which necessitated the relatively higher amount of ^{228}Th than ^{226}Ra in the vegetables. This further justifies the classification of the Jos Plateau as a high background radiation area which is highly rich in thorium Babalola (1984) and Suleiman (1995). Also the concentration of ^{40}K was found to be attributed to poor migration characteristics of radium from the substrate to the vegetables in the concerned environment.

4. Conclusion

The activity concentrations of the radionuclides in the food crops was ranged from 12.36 ± 0.82Bq/Kg to 56.92 ± 8.84Bq/Kg for ^{40}K, 1.46 ± 0.05 to 10.42 ± 0.04Bq/Kg for ^{226}Ra and 1.53 ± 0.08 to 6.85 ± 0.42Bq/Kg for ^{228}Th. However the value obtained suggest that the dose from intake of these radionuclides by the food crops is low and that harmful effects are not expected.

References

Bablola I.A. (1984): Radon measurement and a way of tailings from high natural radioactivity in Plateau state. *Nigerian Journal of Science* 18 (1&2). 92-98.

ColmeneroSujo, L et al (2004): Uranium-228 and Th-232 Series concentrations in soil, Radon-222 indoor and drinking water concentration and dose assessment in the city of Aldama, Chihuahua, Mexico. *J. Environ. Radioac*t77, 205-219.

Holfman R.B (1980): Normal Dietary Levels of Radium-226, Radium-228, Lead-210, Polonium-210 for Man. In natural Radiation environment III proceedings of Int. conf. CONF-7804-22. Ed T.F. Gesell and W.M. Lowder 2 pp 755.

Jibiri N. N Farai, I.P. and Alausa, S.K. (2007): Activity concentration of ^{226}Ra, ^{228}Th and ^{40}K in different food crops from a high background radiation area in Bisichi, Jos Plateau, *Nigeria. Radiat. Environ. Biophys*. 53-59.

Maud P.R and O'Hara J.P (1989). Background radioactivity in environmental materials *J. Environ. Radioact* 9, 265.

Saleh, I H, Hafe A.F, Alanary N.H, Motaoveh H.A and Naim, M.A (2007): Radiological Study of Soils, Foodstuff and Fertilizers in the Alexandria region,Egypt. Turk. *J. Eng. Environ. Sc*. 31, 9-17.

Shanthi G, Maniyam C. G. Raj GAG and Kumaran T.T.J (2009): Radioactivity in food crops from high background radation area in Southwest India. *Current Science* 97 (9, 10) 1331-1335.
Suleiman, M.Y (1995): in analysis of Thorium and Uranium in Malaysian Samples by using EDXRF. *Journal Sains Nukclear* Malaysia 5 (8) 22-29.

Biographies
D.I.Jwanbot obtained a B.Sc(1991) in Physics from University of Jos,Plateau State-Nigeria
He also obtained an M.Sc(1998) in Physics from University of Jos,Plateau State-Nigeria.
He got a Ph.D (Radiation Biophysics) in 2012 from the University of Jos,Plateau State-Nigeria.
M.M.Izam obtained a B.Sc(1986) in Physics from University of Jos, Plateau State-Nigeria.
He also obtained an M.Sc(1992) in Physics from University of Jos ,Plateau State-Nigeria.
He got a Ph.D(Mathematical Physics) in 2010 from University of Jos ,Plateau State-Nigeria.
G.G.Nyam obtained a B.Sc(1997) in Physics from University of Jos,Plateau State-Nigeria.
He also obtained an M.Sc(2004) in Physics from University of Jos ,Plateau State-Nigeria.

Table 1: Activity Concentration for the Food Crops in the Study Area

Food Samples	ACTIVITY CONCENTRATION (Bq/kg)		
	^{40}K	^{226}Ra	^{232}Th
Yam *(Dioscorea* spp*)*	22.12 ± 2.34	2.32 ± 0.62	3.24 ± 0.36
Cocoyam *(Colocasia esculenta)*	20.06 ±1.74	2.66 ± 0.30	3.12 ± 0.18
Irish potatoes *(Solanums* spp*)*	12.36 ± 0.82	6.64 ± 0.08	6.82 ± 0.64
Sweet potato (*Ipomoea batatas*)	14.24 ± 0.62	4.64 ± 0.18	6.42 ± 0.05
Cassava *(Manihot esculenta)*	17.97 ± 1.24	2.25 ± 0.40	2.62 ± 0.16
Onion (*Allies cepa*)	12.53 ± 0.84	1.52 ± 0.08	2.21 ± 0.15
Cucumber *(Cucumis sativus)*	51.34 ± 10.24	4.24 ± 0.18	2.65 ± 0.05
Spinach (*Amaranthus tricolor*)	56.92 ± 8.84	3.47 ± 0.56	2.75 ± 0.06
Garden egg (*Solanum* spp)	23.74 ± 3.62	2.67 ± 0.12	1.53 ± 0.08
Cabbage (*Brassica*)	42.37 ± 5.88	2.73 ± 0.18	2.85 ± 0.42
Lyang Kwan *(Sesamum indicum)*	22.62 ± 1.74	1.46 ± 0.05	1.67 ± 0.16
Green pepper *(Piper nigrum)*	29.44 ± 4.62	4.11 ± 0.44	4.23 ± 0.52
Green beans *(Pisum sativum)*	30.22 ± 4.24	4.22 ± 0.55	4.46 ± 0.82
Carrot *(Daucus carota)*	20.32 ± 1.35	3.86 ± 0.42	3.95 ± 0.30
Okro *(Ahelmoschus esculentus)*	16.24 ± 1.12	5.56 ± 0.04	5.85 ± 0.25
Tomatoes *(Lycopersicum* spp*)*	32.37 ± 14.44	3.84 ± 0.06	3.96 ± 0.17
Vaat *(Brassica rapa)*	24.24 ± 1.16	6.24 ± 0.24	6.85 ± 0.42
Pumpkin *(Cucurbita* spp*)*	28.24 ± 3.12	4.22 ± 0.44	5.58 ± 0.82
Lettuce (*Lactuca sativa*)	30.12 ± 4.16	8.24 ± 2.24	2.36 ± 0.64
Water melon *(Citrullus lanatus)*	32.16 ± 1.16	10.42 ± 0.04	6.24 ± 022

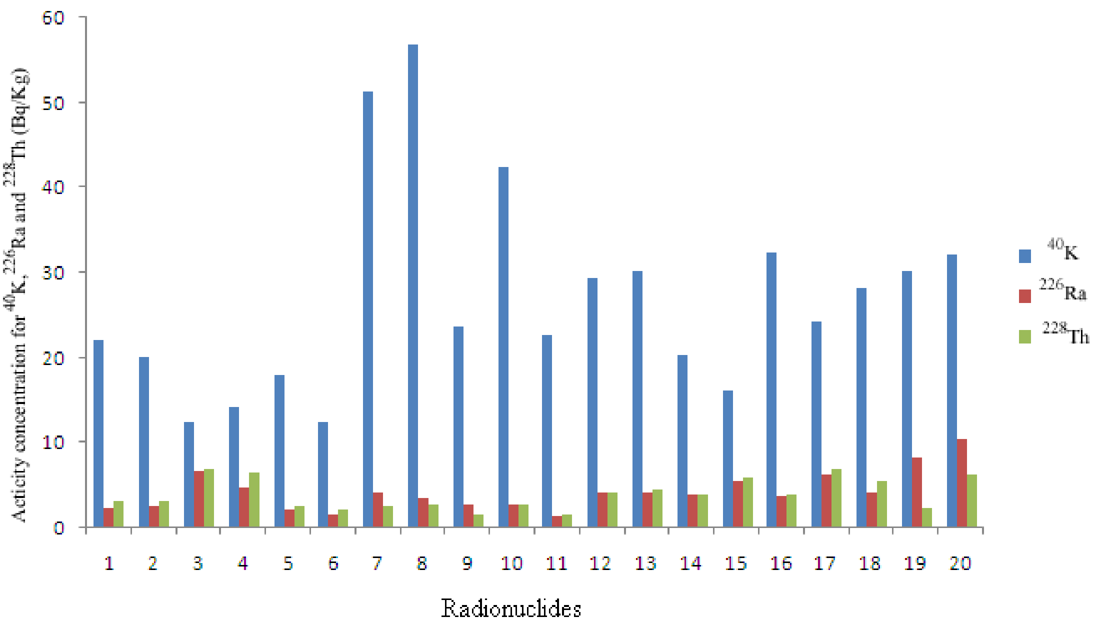

Fig 1: Activity concentration of ^{40}K, ^{226}Ra and ^{228}Th radionuclides in the food crops from the study area