Evaluation Of Radioactivity Concentration And Associated Risks In Pressed Virgin Oil Palm Fruit Oil

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Introduction

The palm oil plantation is one of the cash producing crops in the south western, south eastern and south southern states of Nigeria supplying palm oil and palm kernel products for local farmers, chemical and allied industries. Palm oil contains a good amount of vitamin A and E known to cure various forms of cancer and heart disease. The assessment of accumulation of radionuclides in pressed palm oil is essential because the palm oil can be contaminated from other sources other than the soil. More of the effects of radiation are manifested in pulmonary and kidney cancer, leukaemia and anaemia. Naturally occurring radioactive materials (NORM) (^{40}K, ^{238}U and ^{232}Th) are generally persistent in the environment because they have long half-life and it takes years to completely decay. It is pertinent to assess these naturally occurring radionuclides as a baseline or monitoring evaluation to ascertain that they do not exceed the permissible levels in the environment. The analysis of radionuclides using the Hyper Pure Germanium Detector (HPGe) provide the activities of the radionuclides and other required data for the calculations of risk assessment indices which can be compared with standard and permissible values.

Materials and Methods

Palm oil samples were collected in 1 liter plastic bottles and the containers were labelled PO1-PO15 with respect to the fifteen sampling points which were then transferred to previously cleaned Marinelli beakers. Palm oil samples were kept for a month for the radon gas and its progeny to attain secular equilibrium after which, gamma spectrometry measurements of the samples were carried out to determine the activity concentration of the naturally occurring radionuclide materials in the palm oil samples. The gamma-counting equipment was a Canberra vertical high-purity coaxial germanium (HPGe) crystal detector. The photo-peaks observed with regularity in the samples were identified to belong to the natural radioactive decay series headed by ^{238}U and ^{232}Th, and a third non-series natural radionuclide, ^{40}K, for a counting time of 36000 seconds. The risk assessment indices such as Radium Equivalent (Ra_{eq}), Absorbed Dose Rate (D), and Annual Effective Dose Equivalent (E) were also measured for the palm oil samples.

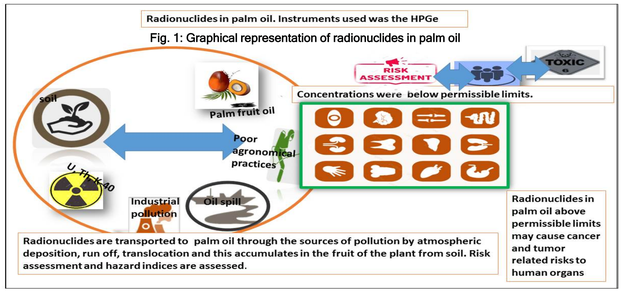

Table 1: Activity for palm oil (Bq/L) 1

Code Palm Oil		Activity of ^{40}K	Activity of ^{238}U	Activity of ^{232}Th
PO1	Abak	236.1±0.02	2.677±0.98	6.881±0.01
PO2	Acharu	214.3±0.01	4.790±0.34	5.432±0.02
PO3	Agbarho	150.4±0.54	4.790±0.11	2.156±0.03
PO4	Ago-Emokpae	187.5±0.02	1.705±0.12	4.243±0.01
PO5	Apoje	367.0±0.03	3.757±0.45	3.461±0.24
PO6	Badagry	122.3±0.01	2.890±0.01	3.443±0.33
PO7	Benin City	347.2±0.02	3.924±0.39	4.311±0.07
PO8	Igede Ekiti	327.8±0.01	2.960±0.11	6.378±0.21
PO9	Ikire	266.7±0.12	3.192±0.15	4.109±0.17
PO10	Iresa Apa	212.5±0.15	2.661±0.41	1.199±0.03
PO11	Nsukka	ND	2.475±0.08	5.249±0.02
PO12	Okitipupa	179.4±0.09	1.240±0.01	8.060±0.01
PO13	Onishere	968.0±0.02	6.030±0.02	5.200±0.01
PO14	Ubiaja	229.8±0.02	1.996±0.01	5.042±0.02
PO15	Umuabi	238.6±0.01	6.651±0.03	1.509±0.01

Table 2: Ra, D, and E in palm oil

Palm Oil Sample Code	$Ra_{(eq)}$ (Bq/L)	D (nGy/h)	E (mSv/y) $\times 10^{-2}$
PO1	30.70	15.24	1.87
PO2	29.06	14.43	1.77
PO3	19.45	9.787	1.20
PO4	22.22	11.17	1.44
PO5	36.97	18.18	2.23
PO6	17.23	8.514	1.05
PO7	36.82	18.90	2.23
PO8	37.32	18.90	2.23
PO9	29.61	15.08	1.86
PO10	20.74	10.81	1.33
PO11	9.981	4.315	0.53
PO12	26.58	12.92	1.60
PO13	88.00	46.29	56.9
P104	26.90	13.55	1.67
PO15	27.18	13.93	1.71

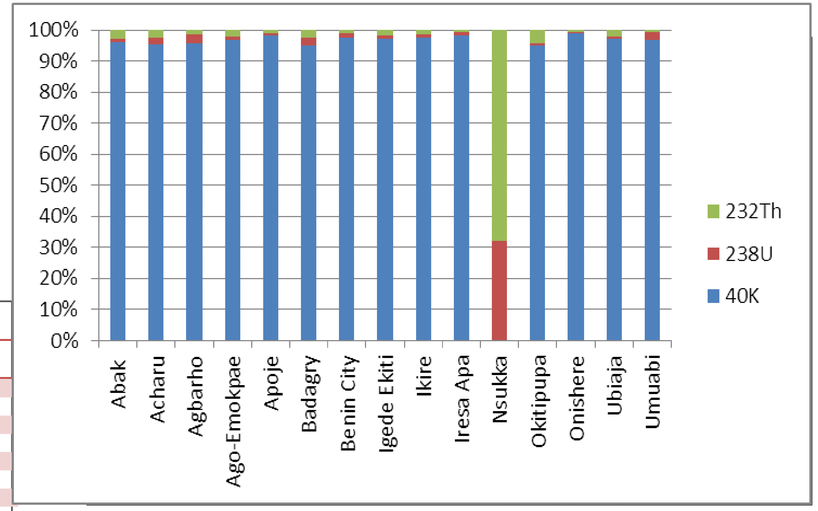

Fig. 2: NORM in palm oil (Bq/L)

Results and Discussions

The activity concentrations in the palm oil ranged from 122.3 to 968.0, 1.240 to 6.651, and 1.199 to 8.061 Bq/L for ^{40}K, ^{238}U and ^{232}Th respectively. The Radium Equivalent, $Ra_{eq,}$ Absorbed Dose Rate, D and the Annual Effective Dose Rate E, in the palm oil samples ranges from 9.981 to 88.00 Bq/L, 4.315 to 46.29 nGy/h, and 0.53 × 10^{-2} to 56.90 x 10^{-2} mSv/y, respectively. These are represented in Tables 1 and 2 and Figure 2. The activity concentration of ^{40}K and ^{238}U were highest in Onishere (PO13) plantation. The activity of ^{232}Th was highest in (PO12) plantation. The activity concentrations reported for palm oil samples were lower than the recommended world average values given by UNSCEAR. Risk assessment indices were also below permissible limits. Figure 1 represents a graphical representation of the methodology and results of the analysis.

Conclusion

Concentrations were below permissible limits and hence NORM in the palm oil cause no risk to humans when consumed

Acknowledgement

The authors wish to thank the Cape Peninsula University of Technology for funding the research and sponsoring attendance of the conference.