UNIVERSITI TEKNOLOGI MARA

STUDY ON RADIONUCLIDES UPTAKE AND RADIATION RISK IN SELECTED VEGETABLES GROWN IN HIGHLANDS AREA OF PENINSULAR MALAYSIA

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Thesis submitted in fulfilment of
the requirements for the degree of
Master of Science

Faculty of Applied Science

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 6th May 2015 to conduct the final examination of Marlinda Binti Musa on her Master of Science thesis entitle "Study on Radionuclides Uptake and Radiation Risk in Selected Vegetables Grown in Highlands Area of Peninsular Malaysia" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173) of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was follows;

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AUTHORS'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution for any other degree or qualification.

I, hereby acknowledge that I have been supplied with the academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The naturally occurring radionuclides which are ^{40}K, ^{226}Ra and ^{228}Ra are naturally present in the environment. However, the anthropogenic activity may cause their content to accumulate in the environment. Due to this, the hyper-accumulation of radionuclides such as ^{226}Ra and ^{228}Ra may cause a toxic especially once it have ingested by human through the contaminated foods such as vegetables. Cabbage, watercress and tomatoes were selected to represent the vegetables in this study. Objectives of this study are to determine the level of natural radionuclides in selected vegetables, soil/growing medium, water and non-organic and organic fertilizers and to estimate the uptake of radionuclides by selected vegetables. Finally the radiological risk analysis will be carried out of these vegetables. This study was conducted in two farmlands in Cameron Highlands, Pahang and one in Lojing, Kelantan. Samples were dried, ground and sieved prior to analysis. Analyses by of radioactivity concentration of radionuclides were done by using Gamma Spectrometer with high resolution hyper pure germanium (HPGe) detector. It has been analyzed after 2 weeks of sample preparation to achieve the equilibrium. For radionuclides concentration (U and Th), the analysis was done by using X-rays Fluorescence Spectroscopy (XRF). The results showed that ^{40}K has the highest concentration of radioactivity (800.00 ± 23.52 Bq/kg, 1072.98 ± 17.40 Bq/kg, 9038.43 ± 52.86 Bq/kg) compared to the ^{226}Ra (112.14 ± 4.99 Bq/kg, 157.55 ± 2.67 Bq/kg, 114.43 ± 2.49 Bq/kg) and ^{228}Ra (671.3 ± 11.53 Bq/kg, 451.32 ± 10.20 Bq/kg , 26.20 ± 5.37 Bq/kg) in the roots, soils and fertilizer samples. For stems, leaves and tomato fruits, the radioactivity concentrations were not so stables. It can be indicating to the plant physiology and metabolism which is depending on the age of the vegetables during collection done. For fertilizer samples, the organic and non-organic fertilizer used in the study areas have a low concentration of ^{226}Ra and ^{228}Ra compared to the other countries. From the overall results and discussion of transfer factor of radioactivity concentration (^{40}K, ^{226}Ra and ^{228}Ra) from the soil to the various parts of plants, it has been showed that essential nutrients which are potassium required by plant will transfer more compared to the others elements. . It can be determined from the results of leaves for cabbages from Bertam Plantation Area and Cameron Bharat Plantation Area where the transfer factor of ^{40}K shows very high which are 32.99 and 3.36 compared to the ^{226}Ra and ^{228}Ra. The lowest transfer factors found in this study are 0.04 for 228Ra from B1 C L and CB1 C L samples. For risk analysis, the Biota Concentration Guide which generated by RESRAD-BIOTA program, all samples collected from all study area have low concentration of radioactivity compared to the limiting guide given by United State Department of Energy which is 2.0^3 Bq/kg for ^{226}Ra and 2.0^3 Bq/kg for ^{228}Ra. Considering the location of the study area, there is a possibility of the H_{ex} higher than unity for soil because it is located on the igneous rock. However, for the others samples the results shows less than unity. Comparing with UNSCEAR 2000, the Ingestion Dose Intake for watercress, cabbages and tomatoes are low, which usually reported in the literature where the consumption doses for vegetables are relatively low compared to the others food consumption.

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