

DETERMINATION OF ESSENTIAL AND TOXIC ELEMENTS INCLUDING  
NATURAL RADIONUCLIDES IN SOME VEGETABLES GROWN  
IN CAMERON HIGHLANDS, PAHANG



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**KELULUSAN PERMOHONAN DANA KECEMERLANGAN FASA 03/2009**  
**TAJUK PROJEK : DETERMINATION OF ESSENTIAL AND TOXIC ELEMENTS**  
**INCLUDING NATURAL RADIONUCLIDES IN SOME VEGETABLES GROWN IN**  
**CAMERON HIGHLANDS, PAHANG**

Dengan segala hormatnya perkara di atas adalah dirujuk.

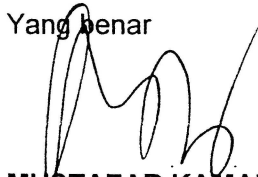
Dengan sukacitanya, Institut Pengurusan Penyelidikan (RMI) mengucapkan tahniah kepada tuan/puan kerana telah berjaya ditawarkan Geran Dana Kecemerlangan bagi projek penyelidikan tersebut tertakluk kepada syarat-syarat dalam lampiran.

Tempoh projek penyelidikan ini ialah dua (2) tahun, iaitu bermula **01 Januari 2010** hingga **31 Disember 2011**. Peruntukan yang diluluskan ialah sebanyak **RM10,000.00** sahaja bagi **Kategori D**. Tuan/puan diminta mengemukakan kertas cadangan penyelidikan beserta bajet yang baru seperti yang dicadangkan dan bersesuaian dengan jumlah kelulusan yang telah diluluskan.

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**“SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA”**

Yang benar



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### 3. Report

#### 3.1 Executive Summary

There are many essential and non-essential elements including metals and radionuclides present in vegetables. However, the accumulation of the several metals and radionuclides may cause contamination to vegetables which later on passed on to the consumer. Green mustard (*Brassica rapa var. parachinensis* L.) and watercress (*Nasturtium microphyllum/ officinale*) were selected to represent the vegetable in this study. Objectives of this study are to determine the concentration of metals and radionuclides in the samples and to calculate the enrichment factor (EF) and also to estimate the uptake, base on biological accumulation coefficient (BAC), for the various parts of selected vegetables. This study also explore the extent of Naturally Occuring Radioactive Materials (NORM) distribution by calculating radium equivalent, absorbed dose, annual effective dose, external hazard index and index of geoaccumulation ( $I_{geo}$ ). Three vegetable farms in Cameron Highlands were studied namely Bharat, Kg Raja and Bertam. All samples (vegetables, soils and fertilizers) except for water samples were dried and converted into powder for measurement. Water samples were acidified using  $HNO_3$  6 M until pH 2 before analysis. Samples analyses were done by using X-rays Fluorescence Spectroscopy (XRF) to measure the concentrations of Fe, Zn, Hg, U and Th; while for radioactivity concentrations, the measurement were done by using high resolution hyperpure germanium (HPGe) detector gamma spectrometry.

The concentration of all elements in the soils is lower than their concentration in the control soil, except for Zn, U and Th. The concentration of all elements in Green Mustard is lower than their concentration in the soil where it was grown. The EF values in the *Brassica rapa var. parachinensis* L are lower than 2 except for U and Th, indicating some degree of contamination due to anthropogenic activities or naturally origin. The BAC values show that Zn and Hg were accumulated in the green mustard and watercress. The radiation hazard for samples were greater than unity and there is no contamination of naturally occurring radioactive material ( $I_{geo} < 1$ ). Generally, only  $^{40}K$  uptake was observed in watercress and no indication that the plant and the study area are of radiological risk.

## 3.2 Introduction

### 3.2.1 Background of studies

Metals and radionuclides uptake by plants in the agricultural area is an important criteria to be measured because of its contribution to the production of food for public consumption. The presence of toxic metals and radionuclides in vegetables will affect human health. There are several factors that contribute to the uptake of toxic metals and radionuclides by vegetables: soil, water resource and fertilizer, since they are in contact with vegetables. Since people are very concerned with their dietary intake, they will only consume foods with recommended nutritious values to ensure that there are no health problems occurring later (Maleki & Zarasvand, 2008).

Vegetables are always said to contain rich nutrients, but somehow, the vegetables may also contain toxic elements which will be transferred and accumulated in the human metabolism system through ingestion and later will be deposited to specific organs. In addition, the toxic elements present also may interrupt the balance of the natural cycle. For these reasons, it is important to study the factors involved in cultivation and farming technique practices by the farmers in growing vegetables which contribute to the level of toxic and essential elements as well as radionuclides in their vegetables.

### 3.2.2 Problem statement

Cameron Highlands is located on top of the granitic rocks which contain higher uranium than the crustal average, thereby making them a potential source of natural radionuclides. In all types of uranium mineralization, it was believed that the granite, in view of its higher uranium content, was considered to be the prime source for uranium and thorium. This was due to lateral geological processes in the quartz pebble conglomerate type and sandstone-hosted uranium deposits related with the existence of uranium and thorium. Toxic metals also present in the earth crust and human activities will bring them to the surface of the ground. This will enable the uptake by plants and wash out by the rain.

The presence of toxic metals and radionuclides in large quantity in vegetables may contribute to the toxicological problem to those who consume it (Stangeeva, 2008). There was no study regarding the presence of toxic metals and radionuclides in vegetables grown in Cameron Highlands, Pahang done in the past. Since Cameron Highlands is a major vegetables producer in the country, therefore, there is a need to study the level of toxic metals and radionuclides in vegetables grown in this area in order to protect the consumers throughout the country.