

## Assessment of heavy metals in soils and vegetables in Cameron Highlands and ex-mining land of S Perak

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### Introduction

In central P. Malaysia, most of the vegetables are grown in Cameron Highlands or on ex-mining land in S. Perak. In Cameron Highlands, the sandy soils of the vegetable terraces are derived from coarse granite while the ex-mining soils are alluvial deposits also derived from granite. Due to the sandy texture, large amounts of chicken manure and chemical fertilizers are added to sustain the vegetable cultivation in both areas. It is a growing concern that long term use of these soil amendments may result in an accumulation of heavy metals in the soils and uptake by the crops. The heavy metal content in agricultural soils is one of the indicators of soil quality and has been used by many countries. Our earlier studies on the assessment of contamination of agricultural soils and crops in P. Malaysia showed that some of our soils already contain elevated values of Cd and Zn and that cabbages may show high values of Cu. (Fauziah *et. al.*, 2000).

In this study, an assessment of the concentration of heavy metals (Cu, Cd, Pb, Ni and Zn) in some common vegetables grown in Blue Valley, Tanah Rata and Brinchang of Cameron Highlands, and some common root crops from farmers plots on ex-mining land around Bidor, Tapah and Sungkai was carried out.

### Materials and methods

In Cameron Highlands, soil samples were collected from terraces and also from the uncultivated areas and saprolites. In Bidor, Tapah and Sungkai, soils were sampled from vegetable plots where root crops such as sweet potato, yam bean, tapioca and Chinese radish were grown. Sandy tailings from uncultivated areas were also sampled for background values. The soil samples from 0 – 20 cm, 20 – 40 cm and 40 – 60 cm were collected using a stainless steel auger. For each site, 3 samples were taken around the plants and combined to form a composite sample. The soils were air-dried and ground to pass through 2 mm stainless steel sieve. They were analysed for pH, total organic carbon and CEC. Total heavy metals (Cd, Pb, Cu, Zn and Ni) were extracted by aqua-regia and analysed by atomic absorption spectrophotometer (AAS). Available heavy metals were extracted by EDTA (ethylene diamine tetra-acetic acid), 0.1M HCl and DTPA (Ranst *et al.*, 1999) and analysed by AAS. The extractant that have a significant correlation and highest value of coefficient correlation can be considered the best extractant to indicate heavy metals uptake by the crop. The main vegetables sampled in Cameron Highlands were lettuce, Chinese flowering cabbage, Chinese white cabbage, tomato, French beans, brinjal and leek. Samples of root crops namely sweet potato, yam bean and tapioca were collected from the ex-mining land. The heavy metals were extracted through dry ashing of the tissues and taken into a solution of 1% nitric acid. The heavy metals (Cd, Pb, Cu, Zn and Ni) were determined using AAS.

### Results and Discussion

The soils in Cameron Highlands had a mean pH value of 6.04. The mean values for cation exchange capacity is 22.46 cmol(+)/kg soil and 1.92% organic carbon respectively. The top soils in the older terraces in Cameron Highlands have the highest concentration of Cu and Zn. The mean concentration of Cd, Pb and Ni are not significantly different between the old and new terraces and the saprolite (C horizons). In the ex-mining land, the mean total heavy metals (Pb, Zn, Ni and Cu) in the soils in the cultivated vegetable plots are significantly higher than in the uncultivated areas. However these values are all within the normal range of other agricultural soils by comparing with the 95 th

percentiles established by Zarcinas (1998). The heavy metal concentrations in the vegetables grown in Cameron Highlands have mean values of Zn: 0.75mg/kg, Cu: 0.27 mg/kg, Ni: 0.14 mg/kg, Pb: 0.03mg/kg and Cd:0.001 mg/kg. Zinc content is also highest in the root crops grown on ex-mining land with values of 4.6 mg/kg, followed by Cu: 0.60 mg/kg, Pb:0.38 mg/kg, Ni :0.56 mg/kg) and Cd: (0.08 mg/kg. These values are all below the maximum permissible concentrations (MPC) as gazetted under the Malaysian Food Act 1983 and Food Regulations 1985 ( Pb: 2 ; Ni: n.a, Zn: 40; Cd: 1 ; Cu: 30 mg/kg). Only available Pb in the soil extracted by HCl showed a significant positive correlation with Pb in the crop ( $r = 0.36$ ,  $n = 47$ ,  $p \leq 0.05$ ). When the correlation analysis was done on crop type, only the available Ni extracted by EDTA showed a significant positive correlation ( $r = 0.48$ ,  $n = 26$ ,  $p \leq 0.05$ ) with Ni in sweet potato. In general the transfer coefficients of the heavy metals for this area. Indicate that Zn and Cd are easily available for plant uptake or very mobile in the soil, Ni is in the intermediate range, while Cu and Pb is less mobile.

### Conclusions

Use of chicken manure in the cultivation of vegetables on sandy soil in Cameron Highlands and sandy in southern Perak has increased the pH, organic matter content and total Pb, Zn, Ni and Cu contents. However, in general, the mean total heavy metals (Pb, Ni, Zn, Cd and Cu) in all the soils studied are still within the normal range of other agricultural soils in the country and also of the uncultivated areas. The range of concentrations for the heavy metals in the vegetables (fresh weight basis) from both areas of study are all below the maximum permitted concentrations (MPC) as gazetted under the Malaysia Food Act 1983 and Food Regulation 1985. However monitoring of these values should still be carried out to ensure that vegetables grown in Cameron Highlands and on ex-mining land are safe for consumption.

### Benefits from the study

The quality of the soils in the vegetable growing areas was established. It was found that all the soils and vegetables show heavy metal contents below the maximum permissible limits and this is good news for the farmers and the Department of Agriculture.

### Patent(s), if applicable:

Nil

### Stage of Commercialization, if applicable:

Nil

### Project Publications in Refereed Journals:

Nil

### Project Publications in Conference Proceedings

1. Zauyah, S, Kamshary M, Fauziah CI and Rosenani AB. 2002. Sustainable production of vegetables on ex-mining land in P. Malaysia : Heavy metals perspective. In Li Dajue (ed) Proc. 2nd Int. Conf. on Sustainable Agriculture for food, energy and industry. Beijing. p.1838-1841
2. S. Zauyah, D., M. Kamshary, I. Che Fauziah, and A.B. Rosenani. 2002. Concentration of heavy metal in some common root crops grown on ex-mining land in S. Perak. : Proc. Malaysian Soc. Soil Sc. Conf. 2002,
3. S. Zauyah, C.I. Fauziah, Rosenani A.B, M. Kamshary and P. Kavitha. 2002 . Assessment of heavy metals in soils and vegetables in Cameron Highlands and ex-mining land of S. Perak. Pameran Rekacipta dan Penyelidikan Fakulti Pertanian 2002, UPM Serdang, Selangor, Malaysia.

### Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
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El Idrissi Aboujaffar Sidi Mohamed	Assessment of heavy metal contamination in soils and vegetables in Cameron Highlands' vegetable farms	Environmental soil science	MAGSc	2002
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