

Short Communication

## **HEAVY METAL CONTENTS OF COMPOSTS MADE USING DIFFERENT RAW MATERIALS**

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### **INTRODUCTION**

As a requirement for intensification of agriculture at present, farmers are increasing the usage of agro-chemicals greater than ever which may escalate soil and water pollution (Kuruppuarachchi and Fernando, 1999; Aponso *et al.*, 2003). It is therefore needed to restore soil health and adopt environmentally benign crop production systems. Organic fertilizers are introduced as an effective tool to rehabilitate the soil and thus use of compost is being promoted. The production of compost from agricultural and industrial wastes, as well as from municipal by products are an important means of recovering organic matter reflecting an essential method of healthy disposal. Generally, heavy metals are considered to be the metallic elements with a density over 5 g/cm<sup>3</sup> (Braddy, 1985) or with an atomic weight greater than that of Fe (Pierzynski *et al.*, 2000). Bockman *et al.* (1990) categorized heavy metals as metallic elements with high specific weight, often toxic to mammals. Heavy metals could be categorized into three groups according to their toxic levels i.e. Toxic (Cd) moderately toxic (Pb, Ni, Hg) and low toxic (Zn, Fe, Mn, Cu) and vulnerability of man to heavy metal toxicity is high when compared to many other animals and plants (Laggerwerff, 1972).

The heavy metals tend to accumulate in human and other animal tissues that enters to the body through the food chain can cause diseases such as heart attack, brain damage, cancer, diseases in digestive system, anemia, gout, chronic nephritis, encephalopathy etc. (Laggerwerff, 1972). Cadmium is toxic to human at high levels causing neuropathological systems and renal dysfunction. In addition the balance of other minerals such as P and Ca in the body could also be disturbed by high intake of Cd (IFDC, 1996). However, limited information is available on heavy metal contents in compost made by using different raw materials in Sri Lanka. In consideration of the ever

increasing use of compost as a source of organic fertilizer for crop production it is important to determine exactly the heavy metal contents of different types of composts. Therefore, this study was aimed to determine the heavy metal contents of compost made by municipal solid waste and other common raw materials.

## MATERIALS AND METHODS

Twenty two compost samples produced by local authorities using municipal solid wastes (MSW) were collected by the Divisions of Soil Science of Regional Agricultural Research and Development Centre (RARDC), Makandura and Regional Rice Research and Development Centre (RRRDC), Bombuwala. Sampled compost were from the units operating in Ja-Ela, Kotikaawaththa, Meerigama, Mathugama, Atthanagalla, Katana, Negombo, Beruwala, Walallawita, Agalawaththa, Bulathsinhala, Kaduwela, Horana, Bandaragama, Seethawaka, Seethawakapura, Hambanthota, Rathgama, Kotapola, Keerikulama, Pannala, Kuliypitiya. Besides, twenty two compost samples made using plant residues and animal manure (PRAM) were collected from the RARDC, Makandura and another twenty two from household compost (HHW) producers who have attended the compost training programme at RARDC Makandura.

Samples were dried to a constant weight in an oven at 60°C and dry matter content of manure was determined. Thereafter, samples were ground to a fine powder using a glass mortar and pestle and 1g of ground compost samples were digested with 10ml of 1:1 perchloric acid : nitric acid mixture in a fume cupboard and dissolved in water (Jackson, 1958). Aliquots of the sample extracts were analyzed for Pb, Cd, Zn, Cu, Ni and Cr contents using atomic absorption spectrophotometer (GBC 932 AB) at appropriate wave lengths. Data were analyzed using analysis of variance (ANOVA) procedure and the mean comparison was done by DMRT at  $p=0.05$ .

## RESULTS AND DISCUSSION

Results revealed that the MSW compost contained significantly higher contents of Cd, Zn, Cr, Pb, Cu and Ni followed by compost made by PRAM and HHW. However contents of these metals in the MSW composts were the acceptable limit when compared that with the maximum permissible level for these metals in composts as per the SLS 2003 (Table 1). Moreover, compost made by PRAM showed significantly higher contents of metals than compost produced by HHP except for Cr. Result indicates considerably higher contents for six heavy metals in MSW composts than the others. Hence, the application of recommended rates of composts for crops is necessary to avoid the buildup

of heavy metals in cultivated soils. In order to further understand the degree of the heavy metal contamination of biosphere by the application of compost, it is necessary to conduct more studies in depth in relation to analysis of composts made by different raw materials, with regard to content of organic matter, toxic compound and heavy metals, and the condition of the natural soils where the composts is spread.

**Table 1. Metal contents on dry matter basis with respect to the used raw materials.**

| Element | Category of feedstock | Content (mg/kg) |                             |        |         | Maximum permissible level(SLS) (mg/kg) |
|---------|-----------------------|-----------------|-----------------------------|--------|---------|--|
|         |                       | Range           | Mean and SD                 | Mode   | SE      |  |
| Cd      | MSW                   | 1.8 - 5.0       | 3.49 ± 0.838 <sup>a</sup>   | 2.90   | 0.1786  | 10                                     |
|         | PRAM                  | 2.0 - 2.9       | 2.57 ± 0.259 <sup>b</sup>   | 2.70   | 0.0550  |  |
|         | HHW                   | 0.1 - 0.8       | 0.43 ± 0.182 <sup>c</sup>   | 0.30   | 0.0388  |  |
| Zn      | MSW                   | 155.9 - 450.5   | 293.82 ± 55.37 <sup>a</sup> | 275.50 | 11.8060 | 1,000                                  |
|         | PRAM                  | 46.4 - 100.5    | 70.05 ± 10.42 <sup>b</sup>  | 59.40  | 2.2220  |  |
|         | HHW                   | 38.7 - 90.48    | 63.77 ± 12.64 <sup>b</sup>  | 62.54  | 2.6950  |  |
| Cr      | MSW                   | 21.23 - 85.37   | 48.79 ± 12.25 <sup>a</sup>  | 45.98  | 2.6110  | 1,000                                  |
|         | PRAM                  | 13.85 - 31.5    | 22.35 ± 4.28 <sup>b</sup>   | 23.50  | 0.9120  |  |
|         | HHW                   | 14.10 - 37.8    | 23.18 ± 16.58 <sup>b</sup>  | 24.50  | 3.5350  |  |
| Pb      | MSW                   | 24.25 - 38.93   | 31.49 ± 3.11 <sup>a</sup>   | 31.25  | 0.6630  | 250                                    |
|         | PRAM                  | 11.25 - 29.54   | 18.51 ± 4.66 <sup>b</sup>   | 13.25  | 0.9940  |  |
|         | HHW                   | 3.9 - 19.85     | 10.26 ± 3.23 <sup>c</sup>   | 11.65  | 0.6890  |  |
| Cu      | MSW                   | 0.10 - 3.6      | 2.02 ± 0.63 <sup>a</sup>    | 2.40   | 0.1340  | 400                                    |
|         | PRAM                  | 0.28 - 2.9      | 1.37 ± 0.40 <sup>b</sup>    | 1.40   | 0.0850  |  |
|         | HHW                   | 0.1 - 0.9       | 0.42 ± 0.17 <sup>c</sup>    | 0.25   | 0.0360  |  |
| Ni      | MSW                   | 20.65 - 56.97   | 39.45 ± 8.64 <sup>a</sup>   | 31.89  | 1.8420  | 100                                    |
|         | PRAM                  | 5.5 - 21.35     | 12.57 ± 4.38 <sup>b</sup>   | 5.90   | 0.9330  |  |
|         | HHW                   | 2.4 - 19.54     | 9.92 ± 4.71 <sup>c</sup>    | 16.54  | 1.0040  |  |

SD=Standard deviation; SE=Standard error of the mean; Values are mean ± SD of 22 samples of compost, analyzed individually in triplicate. Mean values in the same column followed by the same superscript letters are not significantly different at 0.05 level probabilities by DMRT.

Metallic contaminants may occur not only from municipal solid wastes but also from animal manures, sewage sludge and pesticides (Azita Behbahaninia and Ahmad Mirbagheri, 2008). Furthermore, when metals have been bound to the soil, the pH, redox potential, and organic matter content will influence the tendency of the metal to exist in ionic and plant available from (Alina Kabata- Pendias, 2011). Metal uptake by plants depends on the bioavailability of the metal in the water phase, which in turn depends on the retention time of the metal, as well as the interaction with other elements and substances in water (Kabata- Pendias and Adriano, 1995). Hence, the metallic compounds are not degraded during composting but may be converted in to organic

combinations that have less bioavailability than mineral combinations of the metals (Barker and Bryson, 2002). Therefore, further information will be required to determine the long term or short term effect of application of different types of composts in to the soil.

### CONCLUSIONS

MSW composts contained the highest amounts of Pb, Cd, Ni, Cr Zn and Cu in comparison to others. However, the amounts of heavy metals in the tested types of composts were far lower when compared to the acceptable levels of the heavy metals in composts determined by the Sri Lanka Standards Institution (SLS, 2003).

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