Determination of heavy metal contents by atomic absorption spectroscopy (AAS) in some medicinal plants from Pakistani and Malaysian origin

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Abstract: This study depicts a profile of existence of heavy metals (Cu, Ni, Zn, Cd, Hg, Mn, Fe, Na, Ca, and Mg) in some important herbal plants like (H. Integrifolia, D. regia, R. communis, C. equisetifolia, N. oleander, T. populnea, M. elengi, H. schizopetalus, P. pterocarpum) from Pakistan and an antidiabetic Malaysian herbal drug product containing (Punica granatum L. (Mast) Hook, Momordica charantia L., Tamarindus indica L., Lawsonia inermis L.) using atomic absorption spectrophotometer. Heavy metals in these herbal plants and Malaysian product were in the range of 0.02-0.10ppm of Cu, 0.00-0.02ppm of Ni, 0.02-0.29ppm of Zn, 0.00-0.04ppm of Cd, 0.00-1.33ppm of Hg, 0.00-0.54ppm of Mn, 0.22-3.16ppm of Fe, 0.00-9.17ppm of Na, 3.27-15.63ppm of Ca and 1.85-2.03ppm of Mg. All the metals under study were within the prescribed limits except mercury. Out of 10 medicinal plants/product under study 07 were beyond the limit of mercury permissible limits. Purpose of this study is to determine heavy metals contents in selected herbal plants and Malaysian product, also to highlight the health concerns related to the presence of toxic levels of heavy metals.

Keywords: Atomic Absorption Spectroscopy (AAS), pollutants, heavy metals, traditional medicines.

INTRODUCTION

Traditional medicines (TM) have been in used since ages. People around the globe are using TM because of their historical behavior and according to their cultural creeds. According to world health organization (WHO) about 70% of the world population is still depending on TM to fulfill their health needs (Uddin et al., 2012). As traditional medicines (TM) are from natural source, it is a misconception that TM is comparatively safer than synthetic drugs having chemicals. As researchers going advanced, it is found that plants not only contain toxic secondary metabolites, but they are also contaminated with environmental pollutants specially heavy metals, which on long term exposure can lead to serious health issues (Hina et al., 2011).

Traditional medicines industry is very rapidly growing and it was estimated to be US$ 60 billion annually in 2008 (Uddin et al., 2012). In early 50s, 84% of the Pakistani population was depending on traditional and herbal medicines but nowadays this practice has been limited (Alam et al., 2011). In Malaysia, this industry is rapidly growing and people are using traditional medicines as their primary source of healthcare, this can be understood by this that in Malaysia, about US$ 500 million is spent annually on traditional medicines and natural source medicines as compared to about US$ 300 million on allopathic medicine (WHO, 2007). Heavy metals are natural components of the earth's crust. They cannot be destroyed and could enter human body via food, drinking, medicinal plants etc. Heavy metal refers to any elements that have a relatively high density and is toxic or poisonous at low concentrations and examples of heavy metals include mercury, cadmium, arsenic, chromium, thallium and lead. Heavy metals are also referred to as metals having atomic weight greater than sodium, and possess some level of toxicity (Adepoju-Bello et al., 2014). Heavy metals could be toxic and essential: Toxic heavy metals mainly Pb, Cd, Hg and As can cause metal poisoning to the patients. Some heavy metals are essential and required by the human body in trace amounts. However they become toxic when blood level increased. They may cause damage to vital organs of the body like heart, liver, kidneys and brain (Uddin et al., 2012).

Due to globally growing use of medicinal plants, regulatory authorities WHO and FDA are now more concerned with the safety and efficacy of these traditional medicines (Helaluddin et al., 2013). Monitoring of heavy metals is important due to two major reasons. The first reason is environmental pollution. Sources of this environmental pollution include industrial waste, traffic emissions and agricultural items, such as, organic mercury fungicides, insecticide. The second reason is that various traditional medicines, mainly of Asian origin, have been reported many times to contain toxic levels of heavy metals (Adepoju-Bello et al., 2014). FAO/WHO now
Determination of heavy metal contents by atomic absorption spectroscopy (AAS) in some medicinal plants

strongly recommends heavy metal analysis in the TM (Hina et al., 2011).

This article aims to provide the heavy metals content in 09 medicinal important plants from Pakistan and 01 combination herbal drug from Malaysia. Heavy metals were determined using atomic absorption spectroscopy (AAS).

MATERIALS AND METHODS

A total of 10 medicinal plants from Pakistan and Malaysian origin were analyzed using atomic absorption spectroscopy. Out of 10 nine were from Pakistan and was methanolic extracts of different parts of medicinal plants, one was obtained from Malaysia and it was a combination drug in capsule dosage form. Pharmacognostic features of medicinal herbs/products under study are mentioned in table 1.

Analytical grade nitric acid (HNO3) and 70% perchloric acid (HCLO4) supplied from fischer scientific were used as reagents for wet digestion of samples. Solutions were prepared using deionized water. All the glassware were thoroughly washed and rinsed before use.

Standard preparation

The standard solutions for all the heavy metals under study were prepared in three to five different concentrations to obtain a calibration curve by diluting stock standard solution of concentration 1000ppm.

Analysis method

Samples under study were first digested using wet digestion method. Briefly approx. 0.2gms of the sample were taken in 100ml volumetric flask and about 4 ml of HNO3 was added and solution was allowed to stand for few hours than it was carefully heated over water bath till red fumes coming from the flask completely ceased. Flask was allowed to cool at room temperature and than about 4 ml of perchloric acid was added and than flask was heated again over water bath to evaporate till a small portion which was than filter through whattman filter paper no.42 and made up the volume using distilled water till 100ml.

Instrumentation

Heavy metals determination in all the medicinal plants was done using atomic absorption spectroscopy (shimadzu). Standard operating parameters were set and given in table 3. The hollow cathode lamps for Cu, Cr, Cd, Co, Ni, Pb, Zn and Fe (shimadzu) were used as radiation source and fuel was air acetylene. All the samples and standard were run in duplicate.

RESULTS

Heavy metals concentrations in methanolic extracts of medicinal plants from Pakistan and Malaysia was determined using atomic absorption spectroscopy (AAS) and results obtained were tabulated in table 2. Hg content of herbal drugs is mentioned in fig. 1.

Fig. 1: Mercury content of herbal plants/products.

Sodium (Na)

Casuarina equsetifolia showed maximum concentration of sodium i.e. 9.18ppm and on the other hand minimum concentration was found in M. elengi i.e. 2.89ppm. Sodium (Na) content were also present in significant amounts like 8.07 ppm, 7.95ppm, 8.15ppm, 8.84ppm, 8.86ppm, 8.74ppm in H. Integrifolia, R. communis, N. oleander, T. populnea, P. ptero-carpum D. regia respectively. Medicinal herbal drug from Malaysia contains sodium content of 8.98 ppm.

Iron (Fe)

Malaysian herbal drug showed maximum content of Iron (Fe) i.e. 3.16ppm while C. equsetifolia showed minimum amount of iron content of 0.22ppm.

Magnesium (Mg)

T. populnea contains maximum magnesium content i.e. 2.03 ppm and minimum concentration was found in N. oleander i.e. 1.85 ppm.

Calcium (Ca)

Malaysian Herbal drug contains maximum concentration of calcium (Ca) i.e. 15.63ppm while minimum concentration was found in D. regia i.e. 3.27ppm. Calcium content was also present in significant amounts like 6.58ppm, 5.26ppm and 4.11ppm in C. equsetifolia, H. Integrifolia, N. oleander respectively.

Copper (Cu)

Highest concentration of Copper (Cu) was found in T. populnea which is 0.1ppm while least concentration of Cu was found in C. equsetifolia i.e. 0.02ppm. Other plants like M. elengi and Malaysian herbal drug product contains significant amounts of copper i.e. 0.08ppm, 0.05ppm respectively.
Zinc (Zn)
Maximum concentration of zinc was found in Malaysian herbal product which contains about 0.29ppm of zinc while minimum concentration was found in C. equisetifolia i.e. 0.03ppm.

Nickel (Ni)
Highest concentration of nickel (Ni) was found in T. populnea i.e. 0.03ppm while least concentration was found in D. regia and R. communis i.e. 0.01ppm. Ni was not found in medicinal plants like N. oleander, M. elengi and H. schizopetalus.

Manganese (Mn)
Malaysian herbal drug contains maximum concentration of manganese i.e. 0.54ppm while minimum concentration was found in T. populnea and P. pterocarpum i.e. 0.01ppm.

Table 1: Pharmacognostic features of tested medicinal herbs/product

<table>
<thead>
<tr>
<th>S. No</th>
<th>Plant species</th>
<th>Family</th>
<th>Part used</th>
<th>Medicinal importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Casuarina equisetifolia</td>
<td>Casuarinaceae</td>
<td>Fruit</td>
<td>Diarrhea, dysentery, beriberi</td>
</tr>
<tr>
<td>2</td>
<td>Nerium oleander</td>
<td>Apocynaceae</td>
<td>Flower</td>
<td>Cancer, asthma, muscular pain, menstrual pain</td>
</tr>
<tr>
<td>3</td>
<td>Thespesia populnea</td>
<td>Malvaceae</td>
<td>Bark</td>
<td>Hepatoprotective, skin protective, dermatitis, wound healing</td>
</tr>
<tr>
<td>4</td>
<td>Delonix regia</td>
<td>Fabaceae</td>
<td>Flower</td>
<td>Diarrhea, antiallerc</td>
</tr>
<tr>
<td>5</td>
<td>Ricinus communis</td>
<td>Euphorbiaceae</td>
<td>Leaves</td>
<td>Hepatoprotective, analgesic, laxative, emollient</td>
</tr>
<tr>
<td>6</td>
<td>Peltophorum pterocarpum</td>
<td>Malvaceae</td>
<td>Pod</td>
<td>Stomatitis, insomnia, constipation, dysentery, muscular pains, sores, skin disorders, analgesic</td>
</tr>
<tr>
<td>7</td>
<td>Hibiscus schizopetalus</td>
<td>Malvaceae</td>
<td>Flower</td>
<td>Hypolipidemic, antihyperglycemic, analgesic, antipyretic</td>
</tr>
<tr>
<td>8</td>
<td>Mimusops elengi</td>
<td>Sapotaceae</td>
<td>Leaves</td>
<td>antipyretic, analgesic, antidiabetic, hypoglycemic</td>
</tr>
<tr>
<td>9</td>
<td>Holoptelea Integrifolia</td>
<td>Ulmaceae</td>
<td>Flower</td>
<td>antidiabetic, anti diarrhoeal, anti-inflammatory</td>
</tr>
<tr>
<td>10</td>
<td>Malaysian Herbal Product</td>
<td>-</td>
<td>-</td>
<td>antidiabetic.</td>
</tr>
</tbody>
</table>

Table 2: Heavy metals contents of medicinal herbs/products (ppm) against permissible Limits.

<table>
<thead>
<tr>
<th>Element</th>
<th>Na</th>
<th>Fe</th>
<th>Mg</th>
<th>Ca</th>
<th>Cu</th>
<th>Zn</th>
<th>Ni</th>
<th>Mn</th>
<th>Cd</th>
<th>Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible limits</td>
<td>51340**</td>
<td>2000***</td>
<td>614**</td>
<td>10</td>
<td>50</td>
<td>1.5</td>
<td>200</td>
<td>0.3</td>
<td>0.1*</td>
<td></td>
</tr>
<tr>
<td>H. Integrifolia</td>
<td>8.07</td>
<td>1.40</td>
<td>2.01</td>
<td>5.26</td>
<td>0.07</td>
<td>0.20</td>
<td>0.02</td>
<td>0.00</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>D. regia</td>
<td>8.74</td>
<td>1.15</td>
<td>1.93</td>
<td>3.27</td>
<td>0.04</td>
<td>0.09</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>R. commiumis</td>
<td>7.95</td>
<td>0.36</td>
<td>2.02</td>
<td>3.37</td>
<td>0.03</td>
<td>0.09</td>
<td>0.01</td>
<td>0.02</td>
<td>0.00</td>
<td>0.37</td>
</tr>
<tr>
<td>C. equisetifolia</td>
<td>9.18</td>
<td>0.22</td>
<td>1.97</td>
<td>6.58</td>
<td>0.02</td>
<td>0.03</td>
<td>0.02</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>N. oleander</td>
<td>8.15</td>
<td>0.77</td>
<td>1.85</td>
<td>4.11</td>
<td>0.04</td>
<td>0.12</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.56</td>
</tr>
<tr>
<td>T. populnea</td>
<td>8.84</td>
<td>1.44</td>
<td>2.03</td>
<td>3.77</td>
<td>0.10</td>
<td>0.16</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
<td>0.49</td>
</tr>
<tr>
<td>M. elengi</td>
<td>2.89</td>
<td>0.87</td>
<td>2.00</td>
<td>5.08</td>
<td>0.08</td>
<td>0.20</td>
<td>0.00</td>
<td>0.13</td>
<td>0.00</td>
<td>0.43</td>
</tr>
<tr>
<td>H. schizopetalus</td>
<td>0.00</td>
<td>0.47</td>
<td>1.90</td>
<td>3.55</td>
<td>0.05</td>
<td>0.09</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.30</td>
</tr>
<tr>
<td>P. pterocarpum</td>
<td>8.86</td>
<td>0.78</td>
<td>1.95</td>
<td>3.94</td>
<td>0.04</td>
<td>0.15</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.56</td>
</tr>
<tr>
<td>Malaysian Product</td>
<td>8.98</td>
<td>3.16</td>
<td>2.02</td>
<td>15.63</td>
<td>0.05</td>
<td>0.29</td>
<td>0.00</td>
<td>0.54</td>
<td>0.01</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Niaz et al., 2013, * Maobe et al., 2012, ** Khan et al., 2012, *** Omokehide et al., 2013

Table 3: Working parameters of atomic absorption spectrophotometer

<table>
<thead>
<tr>
<th>S. No</th>
<th>Element</th>
<th>Wavelength (nm)</th>
<th>Slit Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Na</td>
<td>589</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>Fe</td>
<td>248.3</td>
<td>0.7</td>
</tr>
<tr>
<td>3</td>
<td>Mg</td>
<td>285.2</td>
<td>0.7</td>
</tr>
<tr>
<td>4</td>
<td>Ca</td>
<td>422.7</td>
<td>0.7</td>
</tr>
<tr>
<td>5</td>
<td>Cu</td>
<td>324.7</td>
<td>0.7</td>
</tr>
<tr>
<td>6</td>
<td>Zn</td>
<td>213.9</td>
<td>0.7</td>
</tr>
<tr>
<td>7</td>
<td>Ni</td>
<td>232</td>
<td>0.7</td>
</tr>
<tr>
<td>8</td>
<td>Mn</td>
<td>279.4</td>
<td>0.7</td>
</tr>
<tr>
<td>9</td>
<td>Cd</td>
<td>228.8</td>
<td>0.7</td>
</tr>
<tr>
<td>10</td>
<td>Hg</td>
<td>253.6</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Cadmium (Cd)
Highest concentration of cadmium was found in H. integrifolia i.e. 0.04ppm while least concentration was found in C. equisetifolia, T. populnea, P. pterocarpum and Malaysian product i.e. 0.01ppm.

Mercury (Hg)
Maximum concentration of Mercury was found in Malaysian herbal drug i.e. 1.33ppm and Minimum concentration was found in D. regia and H. integrifolia i.e. 0.06ppm. Other significant mercuric content was found in H. schizopetalus, N. oleander, P. pterocarpum, T. populnea, M. elengi and R. communis, which are 1.30ppm, 0.56ppm, 0.49ppm, 0.43ppm and 0.37ppm respectively. Mercury was not detected in C. equisetifolia.

DISCUSSION

Casuarina equisetifolia L.
C. equisetifolia (Casuarinaceae) is beautiful tree with dropping branches, 10-50 m high. It is found in dry hill sides of open forests in India, Sri Lanka and Australia (Aher et al., 2010). Part used in this study is fruit. Anticancer properties were reported in leaf extracts. Antidiarrheal activity of bark was also reported. Seeds are anthermimic, antispasmodic and ant diabetic (El-Tantawy et al., 2013). Aqueous extracts of this plant also showed antibacterial activity (Parekh and Chanda, 2007). Wood and bark extract also exhibit antihistaminic properties (Aher et al., 2009). In this study, this medicinal plant contains maximum concentration of sodium (Na) i.e. 9.18ppm which is within the permissible limits. Humans and animals contain sodium in their extra cellular fluids. It plays a major role in depolarizing cell membrane and also to keep water equilibrium in ICF and ECF (Stef et al., 2010). The institute of medicine’s ‘dietary reference intakes (DRIs) Canada recommends Canadian to limit their dietary Sodium intake from 1500mg to 2300mg per day. Authorities like WHO (World Health Organization) recommends limiting sodium to less than 2,000 mg a day and the AHA (American Heart Association) recommends limiting sodium to less than 1,500 mg a day (American Heart Association, 2013). Metals like Hg, Cu, Cd, Mn, Ni, Zn all were under the permissible limits as defined by WHO/FAO.

Nerium oleander L.
N. oleander (Apocynaceae) is evergreen flowering shrub. This ornamental plant frequently grown in parks and gardens (Altace, 2011). Part used in this study is flower. It has been known to be a poisonous plant for animals and human beings either fresh or in dried form. Maximum toxic contents were present in roots and seeds. Suicidal use of this plant has also been reported (Altace, 2011). Metals like Mn and Ni was not detected in this plant. Cd was found to be within the prescribed limits by WHO/FAO. Permissible limits set by WHO, China and Thailand for Cd was 0.3ppm. Mercury content was found to be 0.55ppm which is more than the prescribed limits set by WHO/FAO i.e. 0.1ppm. Inorganic and organic mercury can permanently damage the vital organs like brain, kidneys and growing fetus (Maobe et al., 2012). Mercury exposure causes destruction of neurons in the visual cortex (Clarkson et al., 2003). Children and adults exposed to mercury suffers from a disorder called acrodynia which includes symptoms like leg cramps, irritability, peeling of skin of hands, nose and sole of feet, excessive salivation, photophobia and sleeplessness. Maternal exposure during Pregnancy also causes impaired growth (TEACH Chemical Summary EPA, 2007).

Thespesia populnea L.
T. populnea (Malvaceae) is evergreen medium sized tree upto 10m long. Part used in this study is bark. T. populnea barks and fruits possess curative properties like it is used as astringent, anti-inflammatory, antidiarrhoeal, antibacterial. They also reported for cutaneous treatments like scabies, psoriasis and ringworm (Phanse et al., 2013). T. populnea is also reported to be useful in alzheimer’s disease. Hypoglycemic effect also found in alcoholic bark extracts (Patil et al., 2012). All the metals under study was found within the prescribed limits set by WHO/FAO except mercury which was more than the prescribed limits for medicinal plant set by WHO/FAO. Mercury was found to be 0.49ppm.

Delonix regia L.
D. regia (Fabaceae) is a large tree with distinctive bright red flowers. Parts used in this study are Flower. It is a traditional antidiarrhoeal drug. D. regia flowers exhibit antibacterial, anti-inflammatory and analgesic activity. (Rajbhau et al., 2011). Ethanolic extracts of D.regia flowers showed antidiarrhoeal activity in doses of 100, 250 and 500mg/kg (p.o), which is comparable to loperamide (1mg/kg) (Sarin and Bafna, 2012). Heavy metals like Cu were 0.04ppm which is within the permissible limits. WHO/FAO set for medicinal plants i.e. 10ppm. In China and Singapore medicinal plants should contain not more than 20ppm and 150ppm of Cu respectively. Increased level of copper can cause hair and skin discoloration, metallic mouth taste, nausea, dermatitis. Copper deficiency can cause anemia and congenital inabilities (Maobe et al., 2012). Mn was not detected in D. regia. Mercury was within the prescribed limits as set by WHO/FAO.

Ricinus communis L.
R. communis (Euphorbiaceae) is a 4m high smooth, erect somewhat woody bush. Famously known as castor beans. Castor oil is cathartic and abortifacent and acts as labor inducer. Ricinoleic acid has been used as contraceptive jellies in past times (Sadashiv, 2011) Apart from such deleterious effects, ethanolic extracts of R. communis acts...
as a hepatoprotective agent in doses of 100mg/kg. (Padampriya et al., 2012). Analgesic activity of R. communis was also reported in ethanolic extracts of root bark (Rajeshkumar et al., 2013). All the metals under study was detected and tabulated in table 2 were under permissible limits except mercury which is found to be 0.37ppm which is more than 0.1ppm.

**Peltophorum pterocarpum** (DC. Backer ex Heyne)

P. pterocarpum (Fabaceae) is 15-25m high ornamental tree grown round the World. Part used was pod. Different parts of the tree were used in different conditions like stomatitis, insomnia, skin problems, and constipation. Flowers of P. pterocarpum used for inducing sleep i.e. for the treatment of insomnia. Leaf decoction has been used for treating pains. Flowers are used as astringent and for the treatment of pain after birth and also for lotion for eye troubles (Jash et al., 2014). It also possess antioxidant and anti-hemolytic activity (Khan et al., 2013). All the metals under study was found within the permissible limits except mercury which was found to be 0.55ppm more than the allowable limit of 0.1ppm set by WHO/FAO.

**Hibiscus schizopetalus** (Mast) Hook

H. schizopetalus (Malvaceae) comprises of 275 species and out of all H. schizopetalus is the least studied specie of the genus. It is ornamental shrub grown in different parts if the World. It has been used by colombians to treat cough and cold (Zahid et al., 2012). Flower and leaf extracts of H. schizopetalus possess significant analgesic and antipyretic effects (Zahid et al., 2014). In this plant sodium and manganese was not detected. Out of 10 elements only mercury was found out of permissible limits set by WHO/FAO, it was about 1.29ppm, which is much higher than 0.1ppm set limit. Cd and Ni were not found. Cd fumes inhalation can cause acute pulmonary and kidney damage. It may cause acute and chronic poisoning causing adverse effects on Immune and vascular system (Maobe et al., 2012).

**Mimusops elengi** L.  

M. elengi (Sapotaceae) is an evergreen tree found in different parts of the world. Part used in this study is leaves. Multiple activities have been reported of this plant. Bark of H. schizopetalus reported to have antioxidant, antiulcer, anti-inflammatory, analgesic activities. Boiled leaves are used to treat headaches. Leaf juice is used to treat sore eyes (Kar et al., 2012). M. elengi also possesses diuretic and cognitive enhancing activity. Leaves of M. elengi possesses antipyretic and analgesic activity (Sakshi et al., 2011). M. elengi reported to have hypoglycemic and hypolipidemic activity (Zahid, 2012). In this study Ni was not detected in M. elengi sample. WHO/FAO defines permissible limits for medicinal plants i.e. 1.5ppm. It is required by the body in very small quantity for insulin production in pancreas. Ni toxicity is not very common among humans because its absorption by the body is very low. Nickel itch, an allergic dermatitis is the most common condition, which could occur. It may affect lungs and nasal cavities by acting as a carcinogen. Ni exerts potent toxic effects on peripheral tissues and reproductive system (Maobe et al., 2012). Other metals were within the limits except mercury which was found to be 0.43ppm which is higher than the limits of 0.1ppm.

**Holoptelea integrifolia** (Roxb) Planch

H. integrifolia (Ulmaceae) is a large tree distributed throughout greater part of India. Part used in this study is flower. It is mainly used for gastric issues like inflammation, gastritis, colic, vomiting, and intestinal worms. It is also used for leprosy, diabetes, hemorrhoids. Bark and leaves are used as an astringent, carminative, laxative (Sharma and Singh, 2012). It is also used for hair loss treatment due to herpes Infection (Srivastava et al., 2013). H.integrifolia also possess antitumour activity when given in doses of 250mg/kg and 500mg/kg. It increases the survival time in mice (Kumar et al., 2012). All the metals under study was within the permissible limits including mercury.

**Malaysian drug product**

It is a combination marketed herbal drug product available in markets of Malaysia. It is used as an antidiabetic. It is a combination of Punica granatum, Momordica charantia, Tamarindus indica, Lawsonia inermis.

**Punica granatum**

It is used in the treatment of hematuria, hemorrhoids, dysentery and bronchitis. Roots and bark of P. granatum used as anthelmintic and astringent. Leaf paste is used in conjunctivitis (Rajan et al., 2013). It is also used in the treatment of prostate cancer, artherosclerosis, diabetes, male infertility, arthritis (Jurenka, 2008).

**Momordica charantia** L.

Commonly known as bitter melon. It lowers blood sugar level, prevents jaundice by strengthening liver functions. It is also used in treatment of piles and cholera (Kumar and Bhowmik, 2010).

**Tamarindus indica** L.

Exhibit broad spectrum antibiotic activity. It has potent activity against S. aureus, S. typhi, B. subtilus. Fruit of T.indica reported to be beneficial in abdominal pains (Bhadoriya et al., 2011).

**Lawsonia inermis** L.

L. inermis possess different Pharmacological activities like antioxidant, antimalarial, hepatoprotective, antiinflammatory. Methanolic leaf extracts of L. inermis
used as hypoglycemic, while dried leaf extracts are used as ant carcinogen (Kamal and Jawaid, 2010).

CONCLUSION
All the metals under study in selected herbal plants and Malaysian product were under the prescribed limits except mercury. Mercury was found as a major pollutant and health concern in population using these herbal plants and product. Malaysian ant diabetic drug is a marketed product, which poses a threat to population using this product for diabetes as mercuric content was out of the permissible limit in Malaysian product. Proper guidance must be provided by the regulating authorities for the safety and efficacy of herbal plants during their growth and usage.

REFERENCES


