Evaluation of metal pollution in medicinal plants.

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Abstract: In this study following plants were used: Withinia Coagulas, Sarcococca Saligna, Cronopus Didymus, Senecio Chrysanthamoides, Aerva javanica, Vinca major, Salvadora (yellow), Impatiens walleriana, Pteris vittata, Calotropis procera, Eicohhornia crassipes, Pinus walliachiana. All these plants have different medicinal properties. 10 metals used in study were Magnesium, Potassium, Chromium,Copper, Nickel, Iron, Arsenic, Cobalt, Lead and Cadmium. It was concluded from the study that lead was present in highest amount among all these plats and it could be dangerous. Of all plants *Pinus walliachiana* contained highest amount of lead 450.60 ppb. Other metals were also present but their concentration was less as compared to lead. [Researcher. 2009;1(4):42-49]. (ISSN: 1553-9865).

INTRODUCTION

During the past decades, spice and medicinal plants gained a more important role in agronomy production, pharmacy, and exportation because of their increased use as a raw material for the pharmaceutical industry and pharmaceutical preparations and in the everyday life of the general population. In recent years the cultivation of medicinal and aromatic plants has been achieved with increasing interest in Egypt. The interest in our country for these plants is much greater because of the possibility of exportation. From plant nutrition studies, it is known that plants require a certain amount of trace elements that they respond differently to an enhanced or lowered trace element supply, and that, in some cases, agricultural products may be contaminated with toxic heavy metals (Krug, 1986).

There are two major reasons (De Smet, 1992) to monitor levels of toxic metals in medicinal plants. The first reason, contamination of the general environment with toxic metals, has increased (Ali, 1983). The sources of this environmental pollution are quite varied, ranging from industrial and traffic emissions to the use of purification mud and agricultural expedients, such as cadmium-containing dung, organic mercury fungicides, and the insecticide lead arsenate (Schilcher, 1983; Gosselin et al., 1984; Schilcher et al., 1987). The second reason, exotic herbal remedies, particularly those of Asian origin, have been repeatedly reported to contain toxic levels of heavy metals and/or arsenic.

Several investigators have performed several studies on the residual levels of toxic metals in medicinal herbs (Schilcher, 1982; Ali, 1983, 1987; Peters and Schilcher, 1986; Schilcher et al., 1987). Most studies on residual levels of toxic metals in medicinal herbs have focused on lead, cadmium, and mercury (Schilcher, 1985; Ali, 1987; Schilcher et al., 1987).

The accumulation of heavy metals in some desert plants may open anew perspective for application of these species as 'accumulators' of heavy metals to clean-up contaminated soils in arid environments.

Experimental Procedures

Sample preparation and analysis*:*

The samples were dried to constant weight.1g sample was digested with 20mL of HNO3 /HCl (Anal grade), and heated until evolution of white fumes. Where necessary more acid mixture was added and the sample digested until evolution of white fumes marking the end of the digestion process. The digests were filtered into standard 50mL volumetric flask and made up to mark with distilled water. This was subsequently analyzed for Pb, Cd, Cu, Cr, Co and Fe by air-acetylene flame atomic absorption spectrometry with Graphite Furnace (Hitachi Z – 3000) by the standard calibration technique.

Standard Preparation:

Calibration standards were prepared by dilution of the high purity commercial metal standards (Merck) for atomic absorption analysis.

Quality control and Quality Assurance:

Hitachi A-3000 Atomic Absorption Spectrophotometer (graphite furnace) was used for analysis of arsenic. Known standards were used to calibrate the instrument and to keep a good quality control, our goal was to obtain a correlation coefficient value of as close to 1.0 as possible. Adequate quality assurance measures were carried out to ensure reliability of results. Glassware was properly cleaned and reagents (HNO_3, $HClO_4$ and distilled water) were of analytical grade. Spikes and blanks were also introduced. Results reported are average of duplicates.

Results

Table 1. Metal ion concentration in *Withinia Coagulas*

Sr.No	Name of metal ion	Symbol	Concentration (ppm)
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.20±0.2ppm
2	Potassium	K	4.64±0.1ppm
3	Chromium	Cr	0.00±0.3ppm
4	Copper	Cu	0.15±0.3ppm
5	Nickel	Ni	0.11±0.2ppm
6	Iron	Fe	3.25±0.7ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	207.25±0.1ppb
8	Copper	Cu	0.92±0.2ppb
9	Cobalt	Co	3.69±0.1ppb
10	Arsenic	As	2.03±0.4ppb

Table 2. Metal ion concentrations in *Sarcococca Saligna*

No. of metal ions	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.18±0.2ppm
2	Potassium	K	0.17±0.3ppm
3	Chromium	Cr	0.29±1.2ppm
4	Copper	Cu	0.57±0.1ppm
5	Nickel	Ni	0.12±0.1ppm
6	Iron	Fe	6.72±0.3ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	77.56± 0.3ppb
8	Cadmium	Cd	2.05±0.1ppb
9	Cobalt	Co	4.78±0.3ppb
10	Arsenic	As	4.83±0.1ppb

Table 3. Metal ion concentrations in *Cronopus Didymus*.

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.11±0.3ppm
2	Potassium	K	11.2*20±0.2ppm
3	Chromium	Cr	0.00 ppm
4	Copper	Cu	0.94 ± 0.3ppm
5	Nickel	Ni	0.08±0.02ppm
6	Iron	Fe	11.09± 0.2ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	183.87 ±0.1ppb
8	Cadmium	Cd	3.33±0.3ppb
9	Cobalt	Co	5.07±1.0ppb
10	Arsenic	As	1.10±0.2ppb

Table 4. Metal ion concentration in *Senecio Chrysanthamoides*.

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	1.69±0.4ppm
2	Potassium	K	8.83*20±0.6ppm
3	Chromium	Cr	0.36±0.4ppm
4	Copper	Cu	0.31±0.6ppm
5	Nickel	Ni	0.1±0.5ppm
6	Iron	Fe	17.89±0.3ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	240.06±0.1ppb
8	Cadmium	Cd	2.85±0.4ppb
9	Cobalt	Co	21.86±0.7ppb
10	Arsenic	As	2.30±0.3ppb

Table 5. Metal ion concentrations in *Aerva javanica.*

No. of metal ions	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.18±0.1ppm
2	Potassium	K	11.93*20±0.4ppm
3	Chromium	Cr	0.38±0.5ppm
4	Copper	Cu	0.07±0.4ppm
5	Nickel	Ni	0.19±0.2ppm
6	Iron	Fe	8.84±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	156.60±0.1ppb
8	Cadmium	Cd	1.54±0.4ppb
9	Cobalt	Co	6.40±0.3ppb
10	Arsenic	As	0.15±0.4ppb

Table 6. Metal ion concentrations in *Vinca major.*

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.80±0.2ppm
2	Potassium	K	3.12*20±0.3ppm
3	Chromium	Cr	0.05±0.3ppm
4	Copper	Cu	0.08±0.5ppm
5	Nickel	Ni	0.12±0.4ppm
6	Iron	Fe	3.43±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	132.08±0.3ppb
8	Cadmium	Cd	1.73±0.5ppb
9	Cobalt	Co	7.94±0.4ppb
10	Arsenic	As	0.16±0.3ppb

Table 7. Metal ion concentrations in *Salvadora* (yellow)

No. of metal ions	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.16±0.3ppm
2	Potassium	K	3.12±0.3ppm
3	Chromium	Cr	0.19±0.3ppm
4	Copper	Cu	0.26±0.4ppm
5	Nickel	Ni	0.14±0.7ppm
6	Iron	Fe	2.20±0.5ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	132.08±0.2ppb
8	Cadmium	Cd	2.62±0.4ppb
9	Cobalt	Co	3.30±0.5ppb
10	Arsenic	As	1.25±0.7ppb

Table 8. Metal ion concentrations in *Impatiens walleriana*

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	1.69± 0.2ppm
2	Potassium	K	8.83±0.3ppm
3	Chromium	Cr	0.36±0.1ppm
4	Copper	Cu	0.31±0.2ppm
5	Nickel	Ni	0.1±0.3ppm
6	Iron	Fe	17.89±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	237.97±0.2ppb
8	Cadmium	Cd	2.29±0.3ppb
9	Cobalt	Co	17.49±0.3ppb
10	Arsenic	As	1.35±0.4ppb

Table 9. Metal ion concentrations in *Pteris vittata*

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.19±0.3ppm
2	Potassium	K	15.6*20±0.3ppm
3	Chromium	Cr	0.32±0.5ppm
4	Copper	Cu	0.29±0.7ppm
5	Nickel	Ni	0.08±0.3ppm
6	Iron	Fe	14.22±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	152.52±0.3ppb
8	Cadmium	Cd	3.09±0.4ppb
9	Cobalt	Co	8.03±0.2ppb
10	Arsenic	As	3.56±0.4ppb

Table 10. Metal ion concentrations in *Calotropis procera*

Sr.No	Name of metal ion	Symbol	Concentration in ariel parts	Concentration in roots
Metals analyzed by Flame Atomic Absorption Spectroscopy				
1	Magnesium	Mg	1.58*20±0.4ppm	1.68*20±0.6ppm
2	Potassium	K	50±0.3ppm	3.83±0.3ppm
3	Chromium	Cr	0.36±0.2ppm	0.02±0.5ppm
4	Copper	Cu	0.320.5ppm	0.36±0.4ppm
5	Nickel	Ni	0.1±0.5ppm	0.06±0.3ppm
6	Iron	Fe	14.18±0.6ppm	4.26±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy				
7	Lead	Pb	175.930.1ppb	103.31±0.2pb
8	Copper	Cu	1.23±0.6ppb	2.57±0.5ppb
9	Cobalt	Co	17.580.7ppb	3.44±0.5ppb
10	Arsenic	As	0.150.1ppb	8.04±0.2ppb

Table 11. Metal ion concentrations in *Eicohhornia crassipes.*

Sr.No	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.18±0.5ppm
2	Potassium	K	11.93*20± 0.1ppm
3	Chromium	Cr	0.38±0.3ppm
4	Copper	Cu	0.07±0.4ppm
5	Nickel	Ni	0.19±0.3ppm
6	Iron	Fe	8.84±0.6ppm
Metals analysed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	156.60±0.5ppb
8	Cadmium	Cd	1.98±0.3ppb
9	Cobalt	Co	6.40±0.1ppb
10	Arsenic	As	0.15±0.3ppb

Table 12. Metal ion concentrations in *Pinus walliachiana*

No. of metals	Name of metal ion	Symbol	Concentration
Metals analyzed by Flame Atomic Absorption Spectroscopy			
1	Magnesium	Mg	0.90±0.2ppm
2	Potassium	K	25.37±0.2ppm
3	Chromium	Cr	0.00
4	Copper	Cu	0.09±0.1ppm
5	Nickel	Ni	0.13±0.3ppm
6	Iron	Fe	4.25±0.1ppm
Metals analyzed by Graphite Furnace Atomic Absorption Spectroscopy			
7	Lead	Pb	450.60±0.1ppb
8	Cadmium	Cd	25.37 ±0.2ppb
9	Cobalt	Co	15.41±0.2ppb
10	Arsenic	As	2.40±01ppb

Discussion:

In this study following plants were used: *Withinia Coagulas, Sarcococca Saligna, Cronopus Didymus, Senecio Chrysanthamoides, Aerva javanica, Vinca major, Salvadora* (yellow), *Impatiens walleriana, Pteris vittata, Calotropis procera, Eicohhornia crassipes, Pinus walliachiana.* 10 metals used in study were Magnesium, Potassium, Chromium,Copper, Nickel, Iron, Arsenic, Cobalt, Lead and Cadmium.

All these plants have different medicinal properties. In all these plants lead was present in very high concentration which is dangerous.

In *Sarcococca Saligna* and *Withinia Coagulas* only lead was present in slightly high concentration as compared to other metals. However its concentration as compared to other plants was very low.[Table:1,2]. In *Withinia Coagulas* chromium was not present. However potassium was high.[Table:2]. *Cronopus Didymus* also contained a high concentration of lead and potassium only.[Table:3].In *Senecio Chrysanthamoides* lead, cobalt, potassium and iron were detected at high levels.[Table:4]. *Aerva javanica* potassium, iron and lead were in high amounts [Table:5]. *Impatiens walleriana, Salvadora (*yellow) contained lead in high concentration.[Table:7,8]In *Calotropis procera* magnesium and lead were in high range while other metals were only present in normal amounts[Table:10]

In *Eicohhornia crassipes, Vinca major* and *Pteris vittata* potassium and lead were present in high concentration. Other metals were in very low amounts.[Table:6,9,11]. In *Pinus walliachiana* a very high amount of lead was present. Other metals were normal in concentration. [Table: 12]. Pnus has been reported as a source of for many natural products.

Of all plants *Pinus walliachiana* contained highest amount of lead 450.60 ppb.[Table:12].

Conclusion:

Before using these medicinal plants for remedies of different diseases their metal content should be kept in mind. This is important because otherwise metals may affect us with their harmful effects.

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