Determination of Heavy Metals in Spices and Medical Herbs Available on the Iraq Markets

Isam Jawad

Department of Nutrition, Faculty of Pharmacy and Medical Sciences. University of Petra, Amman, P.O.Box; 961343, Jordan.

Address For Correspondence:
Isam Jawad, Department of Nutrition, Faculty of Pharmacy and Medical Sciences. University of Petra, Amman, P.O.Box; 961343, Jordan.

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ABSTRACT
In the present study concentration of some heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), iron (Fe), manganese (Mn) and copper (Cu) in common spices and medical herbs used in Iraq, since herbs and spices are sources of many bioactive compounds that can improve the tests of the food and used as a raw materials for the pharmaceutical industry. Total of 270 samples which represent different types of spices and medical herbs were collected from different markets. In general the order of concentration of heavy metals in spices was found to follow the order Pb>Cd>Cr. On the other hand, Fe, Mn and Cu was found to be high in all the samples. Levels of total ash was high in some of the spices such as curry powder and Turmeric samples which indicates high contamination. Thus intake of these spices and medical herbs can cause accumulation of these hazardous metals in body.

KEYWORDS: Herbs, Spices, Hazardous Compounds.

INTRODUCTION

Spices and medical herbs usually consist of dried leaves, flowers, bodies, seeds and rhizomes of various plants [14, 5, 10]. Spices usually added to the food in small amounts as a flavoring and appetizing agents [11, 15]. Medical herbs used as a remedy for certain diseases in folk medicine, also used as a raw materials for the pharmaceutical industry and pharmaceutical preparations and in the everyday life of the general population. Many herbs used can present a health risk due to the presence of toxic ingredients like heavy metals [10, 12].

The problem of heavy metals in spices and medical herbs is rather complicated, since their levels in herbs depend on several factors ranging from environment conditions to method of production and processing [6, 18]. Plants may absorb heavy metals from soil, water or air. Medical herbs may easily contaminated during growing and processing. Higher metal concentration in spices and herbs were correlates with the metal pollution in soil, air and water [17]. Heavy metals are dangerous in their form of captions and highly toxic when bonded to their short chains of carbon atoms [20, 8]. Therefore, controlling the heavy metal concentration in both medicinal plants and their products should be made to ensure safety and effectiveness of herbal products [3].

In Iraq, spices and medical herbs are widely used however, their handling is still inadequate (drying, transporting, packaging,...) the objective of this study is to estimate the levels of some trace and heavy metals i.e. Iron, Manganese, Copper, Zinc, Lead, Cadmium, and Chromium that may be present in spices and medical herbs brand available in local market in Iraq. Also the levels of investigated metals were compared with recommended levels by the International Organization

MATERIALS AND METHODS
Seventeen spices and medical herbs (table1&3) were collected from local market in Baghdad. After washing, the samples were dried and powdered. The powdered materials were directly subjected to analysis.

The glassware used for analysis were washed with tap water, then soaked overnight with nitric acid solution and rinsed several times with ultra-pure water to eliminated absorbance due to detergent.

The spices and herbs samples were analyzed for heavy metals Fe, Cu, zinc, Cr, Pb, Cd and Mn using atomic absorption spectroscopy after 1-2g of samples were wet-ashed with nitric, perchloric acid according to method explained by [15, 20, and 18]. Calibration standards were prepared by dilution of high purity commercial metal standards for atomic absorption analysis.

Moisture, total ash, water soluble ash, acid insoluble ash and alcohol extracts were determined according to methods by [14, 15, 4, 8].

RESULTS AND DISCUSSION

The mean concentration levels of trace metals found in 17 spices and medical herbs are summarized in tables (1), and (3). The minerals contents in analyzed plants are in wide range. Highest Fe found in most of spices samples analyzed epically in carry powder (830ppm). The most possible sources of iron contamination would be the condition of storage. As most of these spices were handled without a sufficient packaging. Although there was a high content of iron in all the samples, but it is with the acceptable levels. Iron facilitates the oxidation of carbohydrates, protein and fat to control body weight which is important factor in some diseases [9,13].

Copper concentration was close to 9-11 mg/kg. Copper intake from spices has no effects on health. [13] Vast differences were established in Mn. These differences could probably be the result of plant nutrition and soil conditions [19,139], although copper is an essential element in trace amount but can be toxic at higher level [17]. Zn is an essential metal for the normal functioning of various enzyme system. The maximum tolerable daily intake of Zn is 0.3-1mg/kg. The present study shows that the spices and herbs were rich source of zinc. Just as inordinately high amounts of zinc could be more deleterious than nutritious, the WHO limit is not to be exceeded [17].

As revealed by the analytical data high concentration of lead was found in most of the samples of spices and herbs (table1 and 3). Lead has shown to have toxic impact on a variety of metabolic essential to plant growth and development, including photosynthesis, transpiration, DNA synthesis, and mitotic activity [2]. Sources of lead include metal smelting pigments, lead battery manufacturing and lead contaminated petrol. The highest concentration of lead were in most of spices and medical herbs samples especially curry powder, black paper, chamomile and fenugreek.

Both chromium and cadmium are the known toxic pollutants in the world. At an elevated concentration they are toxic for both plant and animals [1, 7, and 23]. All of our spices and herbs samples bear the concentration levels of chromium that fall into the range of 2.1-3.6 for spices sample and 1.54-2.1 for medical herbs. Cadmium samples were in the range of 0.8-3.6 for the spices sample and 1.53-2.1 for the herbs samples.

Total ash, water soluble ash, acid insoluble ash and alcohol extract percentages were significantly high, such high level indicates the poor quality of the spices samples [6] and the possible presents of levels of crude fibers [22].

Table 1: Levels of Iron, Manganese, Copper, Zinc, Lead, Cadmium, and Chromium present in spices samples(mg Kg).

<table>
<thead>
<tr>
<th>TRACE METALS(PPM)</th>
<th>Black pepper</th>
<th>Red pepper</th>
<th>White pepper</th>
<th>cumin</th>
<th>parsley</th>
<th>Celery</th>
<th>Turmeric</th>
<th>Curry powder</th>
<th>Biryani spices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>481.2±2.47</td>
<td>791.66±6.57</td>
<td>35.78±1.09</td>
<td>9.07</td>
<td>347.08±4.87</td>
<td>561.789±10.35</td>
<td>197.77±5.66</td>
<td>256.33±49.31</td>
<td>830.09±11.54</td>
</tr>
<tr>
<td>Mn</td>
<td>81.55±1.33</td>
<td>24.91±1.9</td>
<td>21.88±0.9</td>
<td>15.5</td>
<td>55.09±2.1</td>
<td>31.32±1.87</td>
<td>35.1±2.0</td>
<td>70.12±3.11</td>
<td>71.56±3.4</td>
</tr>
<tr>
<td>Cu</td>
<td>11.6±0.32</td>
<td>7.03±1.09</td>
<td>5.31±0.89</td>
<td>9.30±1.11</td>
<td>10.9±3.04</td>
<td>7.8±1.34</td>
<td>10.36±2.33</td>
<td>9.30±2.11</td>
<td>6.77±2.91</td>
</tr>
<tr>
<td>Zn</td>
<td>9.99±6.21</td>
<td>11.45±5.65</td>
<td>2.91±1.08</td>
<td>14.4±1.9</td>
<td>16.3±9.1</td>
<td>7.88±3.1</td>
<td>8.50±2.92</td>
<td>34.11±4.1</td>
<td>15.02±2.3</td>
</tr>
<tr>
<td>Pb</td>
<td>5.97±1.09</td>
<td>6.98±2.01</td>
<td>3.21±1.24</td>
<td>9.07±2</td>
<td>3.14±0.89</td>
<td>1.21±0.54</td>
<td>4.99±1.33</td>
<td>7.01±3.11</td>
<td>4.31±2.01</td>
</tr>
<tr>
<td>Cd</td>
<td>2.22±0.47</td>
<td>1.60±0.76</td>
<td>0.8±0.23</td>
<td>1.0±0.12</td>
<td>1.0±0.21</td>
<td>1.0±0.09</td>
<td>1.34±1.08</td>
<td>6.22±1.34</td>
<td>2.46±1.04</td>
</tr>
<tr>
<td>Cr</td>
<td>2.11±0.19</td>
<td>3.59±0.89</td>
<td>4.55±1.01</td>
<td>2.05±1.31</td>
<td>2.21±0.85</td>
<td>3.11±2.02</td>
<td>2.51±1.11</td>
<td>6.76±1.09</td>
<td>4.58±2.56</td>
</tr>
</tbody>
</table>

Table 2: Analytical data for some spices.

<table>
<thead>
<tr>
<th>Spice samples</th>
<th>Moisture%</th>
<th>Total ash%</th>
<th>Water soluble ash%</th>
<th>Acid insoluble ash%</th>
<th>Alcohol Extract %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black pepper</td>
<td>0.16</td>
<td>11.8</td>
<td>4.22</td>
<td>10.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Red pepper</td>
<td>0.13</td>
<td>10.5</td>
<td>11.5</td>
<td>0.9</td>
<td>5.6</td>
</tr>
<tr>
<td>White pepper</td>
<td>0.11</td>
<td>9.3</td>
<td>10.8</td>
<td>1.2</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Table 3: Levels of Iron, Manganese, Copper, Zinc, Lead, Cadmium, and Chromium present in some herbs samples (mg Kg).

<table>
<thead>
<tr>
<th>Medical herbs</th>
<th>Mustard</th>
<th>Fenugreek</th>
<th>Anise</th>
<th>Chamomile</th>
<th>Khuba</th>
<th>Karkade</th>
<th>Saffron</th>
<th>Coriander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>389.2±23.0</td>
<td>228.1±19.8</td>
<td>303.2±31.0</td>
<td>567.3±20.3</td>
<td>645.6±37.0</td>
<td>412.9±33.1</td>
<td>56.5±1.0</td>
<td>356.9±19.8</td>
</tr>
<tr>
<td>Mn</td>
<td>23.5±2.12</td>
<td>14.0±4.31</td>
<td>51.0±1.69</td>
<td>53.1±2.03</td>
<td>34.3±3.12</td>
<td>94.8±2.46</td>
<td>43.56±1.59</td>
<td>13.99±1.77</td>
</tr>
<tr>
<td>Cu</td>
<td>6.94±0.99</td>
<td>5.53±0.87</td>
<td>12.9±1.21</td>
<td>13.1±2.00</td>
<td>8.99±1.72</td>
<td>1.43±0.87</td>
<td>10.11±1.08</td>
<td>11.51±2.09</td>
</tr>
<tr>
<td>Zn</td>
<td>23.0±3.09</td>
<td>31.7±2.078</td>
<td>25.7±3.41</td>
<td>27.5±2.49</td>
<td>36.6±5.56</td>
<td>8.91±129</td>
<td>22.45±3.01</td>
<td>11.69±3.61</td>
</tr>
<tr>
<td>Pb</td>
<td>4.19±1.99</td>
<td>9.3±48.21</td>
<td>5.6±2.09</td>
<td>7.8±3.09</td>
<td>7.0±1.25</td>
<td>0.92±0.13</td>
<td>1.3±0.89</td>
<td>4.58±1.77</td>
</tr>
<tr>
<td>Cd</td>
<td>1.87±0.68</td>
<td>1.53±0.99</td>
<td>2.1±1.02</td>
<td>1.8±4.1</td>
<td>1.46±1.03</td>
<td>1.06±0.99</td>
<td>1.3±0.7</td>
<td>1.7±1.05</td>
</tr>
<tr>
<td>Cr</td>
<td>6.70±1.11</td>
<td>4.3±2.44</td>
<td>14.3±144</td>
<td>7.4±3.09</td>
<td>8.6±3.99</td>
<td>12.0±1.79</td>
<td>14.3±3.19</td>
<td>7.3±2.99</td>
</tr>
</tbody>
</table>

**Conclusion:**

The present study revealed that the trace and heavy metals content of selected spices and medical herbs in Iraqi markets were within the safe limits. These spices and herbs are rich in some trace elements such as Fe and Zn which are essential for human health. On the other hand metals such as Pb, Cr and Cd levels in spices and herbs unlikely to have any significant effects on human health when consumed as part of diet. It should be pointed out that the heavy metals concentrations were within the safety limits and that lead and cadmium, were within the acceptable levels. The determination of heavy metals concentration in spices and medical herbs must become a standard criterion for evaluation of their quality.

**REFERENCES**


