Determination of the microelements content of some medicinal herbs

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Abstract

Microelements, in inorganic form or bind in different combinations (Sel Plex and Fritta), action on humans and animals health, bioproductive performances and meat quality. It were analysed the microelements content for eleven medicinal plants (herbs). The analysed microelements were: Zinc, Manganese, Iron, Copper, Lead and Nickel. Mineral contents were determinate by flame atomic absorption spectrometry (F-AAS) with high resolution continuum source ContrAA 300 spectrometer. The contents in microelements for analysed samples were in range: 15.55 ppm (Phoeniculus) - 1.75 ppm (Rhamnus frangula), for Copper; 41.30 ppm (Artemisia absinthium) - 6.44 ppm (Rhamnus frangula), for Zinc; 83.44 ppm. (Rhamnus frangula) - 25.32 ppm (Chelidonium majus), for Manganese; 175.92 ppm (Taraxacum officinale) - 21.43 ppm (Rhamnus frangula), for Iron; 1.479 ppm (Epilobium montanum) - 0.033 ppm (Plantago major), for Nickel. For Echinacea he rba was not detected Nickel content. The analyzed medicinal plants can be differentiating in three main groups, each of them characterised by appropriate metal composition.

Keywords: microelements, medicinal plants, Zinc, Manganese, Iron, Cooper

1. Introduction

Zinc is a constituent of about 300 enzymes and proteins that participate in all major metabolic processes. As an essential trace element Zinc can impair vital function either by deficiency or excess. Over exposure to Zinc by food, water and air commonly poses no risk to the general population. Dietary reference values for Zinc suggested by various sources (WHO-1996) range from 9.4 to 11.0 mg/day for male adults and from 6.5 to 8.0 mg/day for female adults.

Manganese is one of the essential microelements for plants, animals and humans. It is both a constituent and an activator of several enzymes and proteins in plant, animal and humans, and has around 20 identified functions.

Iron (Fe) is recognized as one of the most important trace elements for animal growth (Brock, 1994). To prevent and treat iron deficiency, exogenous inorganic iron supplementation was popular in the feed...

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industry. Iron sources from feed ingredients and supplements vary widely in their bioavailability to the animal. (Rincker et al., 2005a). In recent decades, it was reported that metal chelated with amino acid or protein has good bioavailability in animal (Kegley et al., 2002; Creech et al., 2004). Studies showed chelated or proteinated sources of Fe has 125-185% relative availability compared with ferrous sulphate (Henry and Miller, 1995).

Cooper deficiency in humans is a rare exception, and would not occur if Cu content were more than 2 mg in the daily diet. The national accepted limit for Cooper in tea is 50.0 mg/Kg (Ordinance 975/1998).

The goal of this paper was to analyse the microelements content for eleven medicinal plants (herbs). The analysed microelements were: zinc, manganese, iron, copper, lead and nickel

2. Materials and Method

Medicinal plants or parts of them are used successfully in treatment of different kind of diseases for those therapeutically properties. Rhamnus frangula, Echinaecae herba, Phoeniculus, Malva silvestris, Crataegus monogyna, Taraxacum officinale, Plantago major, Artemisia absinthium, Epilobium montanum, Chelidonium majus, Melissa Folium are some of the native medicinal plants witch can be found commonly in Romania.

Medicinal plants samples preparation

Eleven medicinal plants samples were collected of Romanian markets. The eleven analysed plants are: Sample 1 - Crusin, Rhamnus frangula; Sample 2 - Echinaecae, Echinaecae herba; Sample 3 - Fenicul, Phoeniculus; Sample 4 - Nalba, Malva silvestris; Sample 5 - Paducel, Crataegus monogyna; Sample 6 - Papadia, Taraxacum officinale; Sample 7 - Patlagină, Plantago major; Sample 8 - Pelin, Artemisia absinthium; Sample 9 - Pufulita, Epilobium montanum; Sample 10 - Rostopasca, Chelidonium majus; Sample 11 - Roinita, Melissa Folium. The metals content from medicinal plants samples were analysed after dry burning of 10g in the quartz capsules at 6500C for 4 hours. After complete burning a nitric acid 0,5 N solution was added up to 50 ml. The solution obtained were used for total metals contents determination by flame atomic absorption spectrometry (F-AAS) with high-resolution continuum source.

Reagents

The standard solutions (1000 mg / l) were analytical grade from Riedel de Haen (Germany). The nitric acid 65% solution used was of ultra pure grade (Merck, Germany). All solutions were prepared using deionised water.

Metals content determination

Analysis of metals content was made with ContrAA-300, Analytik-Jena device, by flame atomic absorption spectrometry (FASS) in air/acetylene flame. The device working parameters (air, acetylene, optics and electronics) were adjusted for maximum absorption for each element. Acetylene was of 99.99% purity. Under the optimum established parameters, standard calibration curves for metals were constructed by plotting absorbencys against concentration (Gergen et all, 1996). In a definite range for each metal a good linearity was observed. The correlation coefficient for the calibration curves (r2) ranged between 0.9745-0.9891. All analyses were made in triplicate and mean values were reported. All the values obtained for metals contents in analysed samples were calculated in mg/kg dry matter (ppm).

Results and discussions

The metals contents of plants are variable, due to the factors like differences between the plants species, geographical area, conditions of drying process. Metals contents in soil are a great importance for their effect of animals and humans, through the biologic chain: soil – plant – feed and food. The accessibility of metals for plants depends on soil reaction, mineral colloids, soil humidity, microbiological activity and organic matter content. Organic matter,
especially humus compounds, can form organic-metallic compounds with high mobility in soil solutions and with high availability for plants (Kabata and Pendias, 2001).

The Cooper, Zinc, Manganese, Iron, Lead and Nickel concentrations in analyzed samples are presented in table 1.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Cooper</th>
<th>Zinc</th>
<th>Manganese</th>
<th>Iron</th>
<th>Lead</th>
<th>Nickel</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Rhamnus frangula</td>
<td>1.75</td>
<td>5.44</td>
<td>83.44</td>
<td>21.43</td>
<td>0.0</td>
<td>0.519</td>
</tr>
<tr>
<td>Echinacea herba</td>
<td>5.67</td>
<td>12.31</td>
<td>35.75</td>
<td>68.41</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>Phoeniculus</td>
<td>15.55</td>
<td>23.98</td>
<td>26.31</td>
<td>63.66</td>
<td>0.0</td>
<td>0.140</td>
</tr>
<tr>
<td>Malva silvestris</td>
<td>5.44</td>
<td>28.19</td>
<td>39.18</td>
<td>66.03</td>
<td>0.0</td>
<td>0.781</td>
</tr>
<tr>
<td>Crataegus monogyna</td>
<td>10.09</td>
<td>25.97</td>
<td>24.44</td>
<td>97.89</td>
<td>0.154</td>
<td>0.942</td>
</tr>
<tr>
<td>Taraxacum officinale</td>
<td>7.32</td>
<td>22.05</td>
<td>44.25</td>
<td>175.92</td>
<td>0.0</td>
<td>0.472</td>
</tr>
<tr>
<td>Plantago major</td>
<td>7.19</td>
<td>27.37</td>
<td>31.09</td>
<td>100.72</td>
<td>0.0</td>
<td>0.033</td>
</tr>
<tr>
<td>Artemisia absinthium</td>
<td>11.14</td>
<td>41.30</td>
<td>53.85</td>
<td>171.52</td>
<td>0.0</td>
<td>0.312</td>
</tr>
<tr>
<td>Epilobium montanum</td>
<td>9.44</td>
<td>26.96</td>
<td>25.95</td>
<td>50.34</td>
<td>3.457</td>
<td>1.479</td>
</tr>
<tr>
<td>Chelidonium majus</td>
<td>8.72</td>
<td>32.64</td>
<td>25.32</td>
<td>109.12</td>
<td>0.0</td>
<td>0.755</td>
</tr>
<tr>
<td>Melissae Folium</td>
<td>10.95</td>
<td>26.73</td>
<td>40.96</td>
<td>108.22</td>
<td>0.0</td>
<td>0.693</td>
</tr>
</tbody>
</table>

**Cooper** is one of several trace heavy metals that are essential to life, despite being as inherently toxic as nonessential trace heavy metals (Cadmium, Lead). Cooper deficiency in humans is a rare exception, and would not occur if Cu content were more than 2 mg in the daily diet. The national accepted limit for Copper in tea is 50.0 mg/Kg (Ordinance 975/1998). For analysed samples Phoeniculus has the highest content in Cooper (15.55 ppm), followed by Artemisia absinthium (11.14 ppm). Rhamnus frangula has the smallest Cooper concentration (1.75 ppm).

The national accepted limit for **Zinc** in tea is 50.0 mg/kg (Ordinance 975/1998). The analysed samples contain Zinc in range 41.30-5.44 ppm. The smaller quantity was determinate for Rhamnus frangula (6.44 ppm) and the higher for Artemisia absinthium (41.30 ppm).

**Manganese** is one essential microelements for plants, animals and humans. It is both a constituent and an activator of several enzymes and protein in plant, animal and humans, and has around 20 identified functions. Crowley et al. (2000) reviewed Mn-containing and Mn-dependent enzymes and proteins, including their structures, functions and distributions. In humans, the range between deficiency and toxicity of Mn is narrow. The recommended ESADDI values for adults range from 2 to 5 mg Mn/day (Schaf, 2004). The contents in Mn for analysed samples were in range 25.32 – 83.44 ppm. The low content was determined for Chelidonium majus (25.32 ppm) and the highest for Rhamnus frangula (83.44 ppm).

**Iron** is an essential element for humans, ranging to approx. 4200 mg/body. Approximately 60% of it is bound in haemoglobin and 10% in Fe-dependent tissue enzymes. The remaining 20% and 10% are stored as ferritin and respectively hemosiderin. The Fe turnover is approximately 30 mg/day (Schumann and Elsenhaus, 2004). Iron can not produce toxic effects in usual amounts. Nevertheless, the sum of published data...
suggests that Fe repletion beyond requirement may be hazardous (Schumann, 2001). Taraxacum officinale has the greatest content in Iron (175.92 ppm), followed by Artemisia absinthium (171.25 ppm). Rhamnus frangula has the smallest content in Fe (21.43 ppm).

Nickel is an essential element for animal nutrition. The Nickel requirement of humans has been estimated to be 25-35 µg/day (Anke et. al., 1995). Epilobium montanum has the great content in Nickel (1.479 ppm), followed by Crataegus monogyna (0.942 ppm). For Echinacea herba was not detected Nickel content.

Lead is not an essential element for life and it is very toxic for the nervous system and for the kidneys. The national accepted limit for Lead in tea is 5.0 mg/Kg (Ordinance 975/1998).

The cases - dendrogram obtained using Cu, Zn, Mn, Fe, Pb and Ni like variables is presented in Figure 1:

![Figure 1. The cases – dendrogram](image)

This dendrogram shows that analyzed medical plants can be differentiate in three main groups, each of them characterised by appropriate metal composition.

First group contains only *Rhamnus frangula*, which has the highest content in Mn (83.44 ppm).

The second group is formed by two subgroups. First subgroup contains *Echinacea* herba, *Malva silvestris*, Phoeniculus and Epilobium montanum, plants characterized by a medium Zn, Mn and Fe contents.

The plants of secondary subgroup are: *Crataegus monogyna, Plantago major, Chelidonium majus* and *Melissae Folium*, which have also a medium contents in Zn and Mn, but higher content in Fe than the first subgroup.

Taraxacum officinale and *Artemisia absinthium* are the plants included in the third group, characterized by high contents in Cu (7.32 ppm, respectively 11.14 ppm), Zn (22.05 ppm, respectively 41.30 ppm) and Mn (44.25 ppm, respectively 53.85 ppm). Also in these plants were detected...
the highest content in Fe (175.92 ppm, respectively 171.52 ppm).

Conclusions
The contents in microelements for analysed samples were in range: 15.55 ppm (Phoeniculcus) - 1.75 ppm (Rhamnus frangula), for Cooper, 41.30 ppm (Artemisia absinthium) - 6.44 ppm (Rhamnus frangula), for Zinc; 83.44 ppm. (Rhamnus frangula) - 25.32 ppm (Chelidonium majus), for Manganese; 175.92 ppm (Taraxacum officinale) - 21.43 ppm (Rhamnus frangula), for Iron; 1.479 ppm (Epilobium montanum) - 0.033 ppm (Plantago major), for Nickel. For Echinacea herba was not detected Nickel content.

The analyzed medical plants can be differentiating in three main groups, each of them characterised by appropriate metal composition.

Acknowledgements
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References