

Determination of the Macro Elements Content of Some Medicinal Herbs

Ducu Sandu Ștef¹, Iosif Gergen¹, Lavinia Ștef¹, Monica Hărmănescu¹, Cecilia Pop², Mărioara Drugă¹, Gabriel Bujancă¹, Mirela Popa¹

¹ Banat's University Of Agricultural Sciences and Veterinary Medicine, 300645, Calea Aradului, 119, Timișoara - România

² University Of Agricultural Science, Iasi- România

Abstract

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. Analysis of metals content was made with ContrAA-300, Analytik-Jena device, by flame atomic absorption spectrometry (FASS) in air/acetylene flame. It were analyzed the macro elements content for 33 medicinal plants. The main macro elements (Ca, Mg K and Na) were quantified for each sample. The contents in macroelements for analysed samples were in range: 3.763 % (Plantago major) – 0.442 % (Hippophae rhamnoides), for Ca; 0.718% (Urtica dioica) – 0.107% (Hippophae rhamnoides and Pinus), for Mg; 1.417% (Chelidonium majus) – 0.319% (Rhamnus frangula), for K and 1.945% (Cynara scolymus) – 0.021% (Pinus), for Na.

Keywords: calcium, macroelements, magnesium, medicinal plants, potassium, sodium

1. Introduction

Calcium, sodium, potassium and magnesium are the major components in the cells and extracellular fluids of organism [1].

Calcium is an alkaline-earth metal and it is essential for animals and humans, particularly in cell physiology. A deficit in *Calcium* can affect the formation of bone and tooth, but the excess retention can cause kidney stones.

Calcium is not only a soil component, but it is an important macroelement too. Calcium performs many functions in plants. It sustains the stability of cell wall. The main Ca^{2+} function is to transmit external, in point of plant and cell, signals. Many authors make the following Calcium signalling functions: response to phytohormones [2]; response to pathogen diseases elicitors [3] and response to abiotic environmental factors [4].

The ratio of calcium to phosphorus content (Ca/P) in soil, plants, fodder and human diet is an indicator of equilibrium necessary to the regular run of processes in food chain [5].

Sodium is an alkaline metal and has very important roles in many physiological processes. *Sodium* is present in extra cellular fluids in animals and humans. It is responsible for depolarization of cellular membrane and for the water equilibrium in intra- and extra cellular medium. In blood *Sodium* concentration is about 10 times more than in intracellular medium.

Potassium is also an essential macro-element for human. It is important because: is involving in muscles contraction, in lipids metabolism, in proteins synthesis, maintaining the fluid and electrolyte balance in the body and is responsible in the nerve impulses sending. The necessary daily intake is between 2-4 g/day [6].

Magnesium is important to all the cells from humans. It is present in many enzymes involved in

* Ducu Ștef, 0720687239, ducu_stef@yahoo.com

proteins, lipids and carbohydrates metabolisms. In plants *Magnesium* is present in chlorophylls. Medicinal plants or parts of them are used successfully in treatment of different kind of diseases for those therapeutically properties. The aim of this study was to determine the concentrations in Na, K, Ca, Mg and total ash of the enumerated medicinal plants.

2. Materials and methods

Medicinal plants samples preparation

Thirty three medicinal plants samples were collected of Romanian markets. The analysed medicinal plants are: *Achillea millefolium*, *Arnica montana*, *Artemisia absinthium*, *Calendula officinalis*, *Capsella bursa pastoris*, *Chelidonium majus*, *Crataegus monogyna*, *Cynara scolymus*, *Echinaceae herba*, *Epilobium montanum*, *Equisetum arvense*, *Galium mollugo*, *Hippophae rhamnoides*, *Hypericum perforatum*, *Malva silvestris*, *Matricaria chamomilla*, *Melissae Folium*, *Mentha piperita*, *Phoeniculus*, *Pinus*, *Plantago major*, *Poligonum aviculare*, *Rhamnus frangula*, *Rosa canina*, *Salix babylonica*, *Salvia officinalis*, *Symphytum officinale*, *Taraxacum officinale*, *Thy mi herba*, *Tilia platyphyllos*, *Urtica dioica*, *Valeriana officinalis*, *Violae tricoloris herba*.

The metals content from medicinal plants samples were analyzed after dry burning of 10 g in the quartz capsules at 650°C for 4 hours. After complete burning a nitric acid 0.5 N solution was added up to 50 mL. The solutions 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 deionized water.

Metals content determination

Analysis of metals content was made with ContrAA-300, Analytik-Jena device, by flame atomic absorption spectrometry (FAAS) 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 absorbency against concentration [7]. In a definite range for each metal a good linearity was observed. All analyses were made in triplicate and the mean values were reported. All the values obtained for metals contents in analysed samples were calculated in mg/kg dry matter (ppm). Statistical interpretation of data obtained using multivariate analyses was performed with Statistica-6 software.

3. Results and discussion

The results obtained for contents in Calcium, Magnesium, Sodium, Potassium and total ash for analyzed medicinal plants are presented in table 1. **Calcium** deficiency for a long time is responsible for osteoporosis, when the bones are deteriorated and increased the risk of fractures. The necessary daily intake is between 350 and 1100 mg/day (Mogos, 1997).

In analyzed medicinal plants the Calcium contents varied between 3.763 – 0.442 %. The highest **Calcium** content was obtained for *Plantago major* (3.763%), followed by *Urtica dioica* (3.523%) and *Cynara scolymus* (3.29%). The smaller **Calcium** concentration was determinate for *Hippophae rhamnoides* (0.442%).

Magnesium deficiency in humans caused muscle spasms, and has been associated with a high blood pressure, many cardiovascular diseases, diabetes and osteoporosis. The necessary daily intake is 350 mg/day for men and 300 mg/day for women (Mogos, 1997).

The values obtained for Magnesium in analyzed medicinal plants ranged between 0.718 – 0.107%. The highest content was measured in *Urtica dioica* (0.718%) and the smallest in *Pinus* and *Hippophae rhamnoides* (0.107%).

From analyzed medicinal plants the higher **Potassium** concentrations were determinate for *Chelidonium majus* (1.417%) and *Malva silvestris* (1.35%) and the lower for *Rhamnus frangula* (0.319%).

Table 1. The concentrations in Calcium, magnesium sodium, potassium and the total ash for analyzed medicinal plants

Specification	Ca %	Mg %	K %	Na %	Sum	Ash %
Arnica montana	0.921	0.369	1.189	0.109	2.588	8.06
Cynara scolymus	3.29	0.361	1.094	1.945	6.69	16.674
Hippophae rhamnoides	0.442	0.107	0.796	0.124	1.469	2.628
Thy mi herba	1.919	0.238	1.005	0.064	3.226	7.69
Equisetum arvense	2.197	0.433	1.117	0.078	3.825	15.65
Achillea millefolium	1.731	0.201	1.072	0.075	3.079	8.184
Rhamnus frangula	2.633	0.152	0.319	0.075	3.179	5.146
Echinaceae herba	1.78	0.266	1.092	0.105	3.243	7.89
Phoeniculus	1.559	0.358	1.148	0.128	3.193	8.448
Calendula officinalis	1.151	0.327	1.224	0.642	3.344	12.868
Rosa canina	1.827	0.263	1.053	0.079	3.222	6.248
Mentha piperita	1.96	0.268	1.087	0.127	3.442	6.624
Matricaria chamomilla	2.348	0.28	1.251	0.173	4.052	9.2
Malva silvestris	2.348	0.261	1.35	0.082	4.041	14.046
Crataegus monogyna	2.141	0.248	0.984	0.026	3.399	6.698
Taraxacum officinale	1.155	0.155	1.142	0.027	2.479	14.196
Artemisia absinthium	1.61	0.294	1.316	0.068	3.288	7.114
Pinus	0.465	0.107	0.676	0.021	1.269	3.296
Plantago major	3.763	0.484	1.295	0.099	5.641	15.806
Epilobium montanum	1.75	0.304	0.927	0.037	3.018	5.414
Melissae Folium	1.724	0.375	1.066	0.033	3.198	6.748
Chelidonium majus	1.55	0.225	1.417	0.061	3.253	15.278
Salvia officinalis	2.176	0.458	0.915	0.051	3.6	9.574
Salix babylonica	3.417	0.162	0.3836	0.033	3.996	7.816
Galium mollugo	1.867	0.214	1.059	0.088	3.228	7.04
Hypericum perforatum	0.928	0.268	0.957	0.115	2.268	4.616
Symphytum officinale	0.703	0.152	1.381	0.111	2.347	11.29
Tilia platyphyllos	2.281	0.306	1.095	0.111	3.793	7.026
Capsella bursa pastoris	1.39	0.299	1.316	0.099	3.104	9.154
Violae tricoloris herba	1.301	0.307	1.291	0.094	2.993	11.6
Poligonum aviculare	1.108	0.345	1.222	0.137	2.812	8.818
Valeriana officinalis	0.987	0.405	1.205	0.096	2.693	10.07
Urtica dioica	3.523	0.718	1.305	0.12	5.666	15.192

The lower contents in **Sodium** for analyzed medicinal plants were determinate in Pinus (0.021%) and Taraxacum officinale (0.027%). The highest content in Sodium was obtained for Cynara scolymus (1.945%).

Using the variables Sodium, Potassium, Magnesium and Calcium it was performed the calculation of cases - dendrogram, presents in Figure 1.

Macroelements divided all the analyzed medicinal plants in three main clusters. First cluster are

formed by *Arnica Montana*, *Poligonum aviculare*, *Valeriana officinalis*, *Taraxacum officinale*, *Hypericum perforatum*, *Symphytum officinale*, and *Calendula officinalis*, characterized by appropriate contents in Ca (0.703 – 1.151 ppm), K (0.957 – 1.382 ppm) and Na (0.027 – 0.642 ppm).

Hippophae rhamnoides and *Pinus* are also included in this cluster, but has smaller contents in Ca (0,442 ppm, respectively 0,465 ppm), Mg (107 ppm), and K (0.796 ppm, respectively 0.676 ppm).

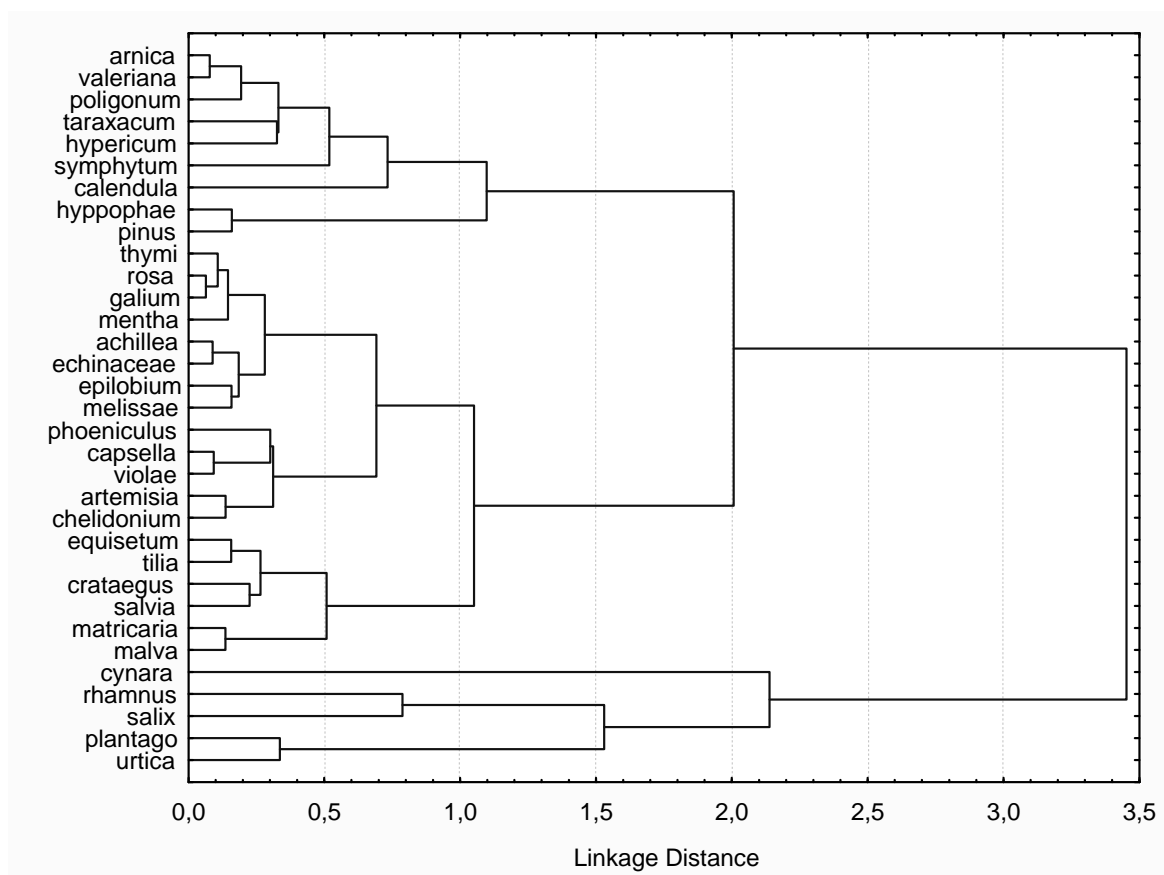


Figure 1 Clusters of medicinal plants using macroelements

The second cluster was divided in three groups, Ca being the determinant element for this organization. One group is formed from *Thymi herba*, *Rosa canina*, *Galium mollugo*, *Mentha piperita*, *Achillea millefolium*, *Echinaceae herba*, *Epilobium montanum*, and *Melissae folium* with medium values for Ca (1,724 - 1,96 ppm). *Phoeniculus*, *Capsella bursa pastoris*, *Violae tricoloris herba*, *Artemisia absinthium*, and *Chelidonium majus* formed the second group with the smaller Ca contents (1.301 – 1.61 ppm). The highest contents from the medicinal plants of this cluster were identified in the third group (2.141 – 2.348 ppm)

The third cluster included *Cynara scolymus*, *Rhamnus frangula*, *Salix babylonica*, *Plantago major*, and *Urtica dioica* with the highest contents of Ca (2.633 – 3.763 ppm).

For cluster analysis it was used Statistica-6 software. The coefficients of matrix correlation of variables are presented in Table 2.

Table 2 Correlation of the macroelements concentrations of medicinal plants

Macroelements	Ca	Mg	K	Na
Ca	-			
Mg	0.45	-		
K	-0.12	0.42	-	
Na	0.26	0.14	0.08	-

Marked correlations are significant at $p < 0.05$

No consistent correlation coefficients were found between the concentrations of macroelements of medicinal plants.

4. Conclusions

The contents in macroelements for analysed samples were in range: 3.763 % (Plantago major) – 0.442 % (Hippophae rhamnoides), for Ca; 0.718% (Urtica dioica) – 0.107% (Hippophae rhamnoides and Pinus), for Mg; 1.417% (Chelidonium majus) – 0.319% (Rhamnus

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Acknowledgements

This work was supported by CNCSIS –UEFISCSU, project number 1116/2009 PNII – IDEI, code 896/2008

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