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TEAS OF *EQUISETI HERBA*, *MYRTILLI FOLIUM* AND *SALVIAE FOLIUM*

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Equiseti herba, *Myrtilli folium* and *Salviae folium* drugs and teas were examined for metal ion-, sulfur-, phosphorus-, total polyphenol- and vitamin C content. Metal elements (Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Hg, Li, Mg, Mn, Mo, Na, Ni, Pb, Ti, V, Zn), sulfur and phosphorus of samples were determined by ICP-AES (inductively coupled plasma atomic emission spectrometry). *Salviae folium* proved to contain iron, magnesium and zinc in the highest level (956.8, 6075 and 33.26 mg kg^{-1}). The teas contained dissolvable metal ions and polyphenols. The dissolution of calcium, magnesium, potassium and zinc was the highest from *Equiseti herba* (27.7, 46.6, 83.2 and 14.3%). The amount of polyphenol content was the higher in the drug (12.8%) and tea (3.6%) of *Salviae folium. Myrtilli folium* was found to contain extremely high amount of vitamin C (470 mg%).

Keywords: *Myrtilli folium*, *Equiseti herba*, *Salviae folium*, metal-, phosphorus- and sulfur content

Medicinal plant teas are often used as appetizers and digestion stimulants. The favourable therapeutical effect of teas is presumably due to the combined effect of organic and inorganic compounds, e.g., metal ion complexes of organic constituents. Thus, we have analysed the metal ion content (magnesium, potassium, etc.) and the quantity of some organic ingredients (vitamins, polyphenols) dissolved from *Equiseti herba*, *Myrtilli folium* and *Salviae folium*. The plants have another indication field as well, for example, the use of herbs in folk medicine for the treatment of diabetes mellitus II can be traced back over thousands of years. Herbal teas are effectively applied even in our days in adjuvant therapy to prevent complications of diabetes mellitus II. The therapeutic effect of polyphenol compounds of plant drugs is also widely acknowledged. The mineral elements of these plants and extracts have, however, not been examined so far. The role and importance of metals (Mg, Mn, Zn, etc.) in the preservation of health have been known for a long time (LEACH, 1967; CHANDRA, 1988;

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SIRO et al., 1995; LAKATOS et al., 1997a; b). Magnesium deficiency may lead to the development of different diseases and may result in an increased blood glucose level (RUDE, 1989; BARBAGALO et al., 1993; FAZEKAS et al., 1994).

1. Materials and methods

Commercially available drugs (*Equiseti herba*, *Myrtilli folium*, *Salviae folium*) of collected medicinal plants (*Equisetum arvense*: wild horsetail; *Vaccinum myrtillus*: blueberry; and *Salvia officinalis*: sage) and the aqueous extracts (tea) of the drugs were examined.

1.1. Determination of element content

Concentrations of the elements of samples from different locations were determined by ICP-AES (inductively coupled plasma atomic emission spectrometer). Type of instrument: Atom Scan 25 (Thermo Jarrell Ash), a sequential plasma emission spectrometer. Sampling: the samples (0.5 g) were digested with a mixture of HNO_3 (5 ml) and H_2O_2 (3 ml) in teflon vessels. After digestion the samples were diluted to 25 ml, from which the following elements were determined in three parallel measurements: Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Hg, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Ti, V, Zn.

1.2. Chemical analytical methods for the measurement of organic ingredients

The total polyphenol content of the herbs was determined by the PHARMACOPOEIA HUNGARICA (Ph. Hg. VII, 1992) by spectrometry. Twenty g of plant material was shaken with water for 1 h under room temperature. To each sample 1 ml of Folin reagent and 17 ml of sodium carbonate solution (14.0 g anh. Na_2CO_3 in 100 ml H_2O) were added.

Vitamin C content of the samples was determined by spectrometry according to Ph. Hg. VII. as follows: 2 g of the crude drug was boiled with a mixture of water (60 ml) and acetic acid (2 ml, 2 mol l^{-1}) for ten minutes then cooled and filtered into a 200 ml volumetric flask. After repeated washing of the drug, the content of the volumetric flask was diluted to 200 ml. Iron/III/-ammonium-sulfuric solution (2 ml), 1% aqueous solution of citric acid (10 ml), 1% ethanol solution of α-α'-dipyridyl (0.4 ml), 20% aqueous solution of ammonium acetate (10 ml) and 10 ml of the plant extract were measured into a 100 ml flask. The reaction mixture was kept in the dark for 120 min then diluted to 100 ml with bidistilled water. Absorbance was measured at 525 nm. The reference solution was prepared likewise, the difference was that dipyridyl solution was replaced by ethanol.

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The ash and crude material content of the herbs were measured according to the PHARMACOPOEIA HUNGARICA (Ph. Hg. VII, 1992).

1.3. Preparation of tea

Out of the drug samples of different locations one was chosen for tea preparation. Approximately 5 g of the drug was boiled in 100 ml bidistilled water for 10 min. While hot the mixture was filtered.

1.4. Statistical analysis

Mean values and standard deviation (SD) were calculated from the results. One way analysis of variance was applied for comparison of the mean values.

2. Results

Element concentration in the crude drug samples is depicted in Table 1. The results obtained are in agreement with literature data (KABATA-PENDIAS & PENDIAS, 1984) and our previous results (THEN et al., 1998; THEN & SZENTMIHÁLYI, 1998). No concentrations higher than the detection limit were measured in toxic elements (As, Cd, Hg, Pb), therefore these elements are omitted in tables. *Salviae folium* contains iron, magnesium and zinc in the highest level (956.8, 6075 and 33.26 mg kg^{-1}), while the concentration of calcium (21834 mg kg^{-1}), cobalt (0.773 mg kg^{-1}), copper (8.74 mg kg^{-1}), potassium (28201 mg kg^{-1}), sodium (408.7 mg kg^{-1}), phosphorus (2346 mg kg^{-1}), sulfur (16054 mg kg^{-1}) and titanium (3.58 mg kg^{-1}) was the highest in *Equiseti herba*.

One way analysis of variance was used for the statistical comparison of samples. Significant differences ($P<0.05$) were found in the concentration of aluminum, barium, iron, potassium, lithium, magnesium, sulfur, nickel, phosphorus, manganese, boron, molybdenum, chromium, calcium and sodium between drugs.

The most frequently applied method of extraction is tea making. The element concentration of teas and the amount of elements dissolved in tea expressed in percentage are also included in Table 2. The concentration of some elements in teas was relatively low. The highest amount of calcium (358.4 mg l^{-1}), copper (0.035 mg l^{-1}), phosphorus (59.6 mg l^{-1}), sulfur (70.60 mg l^{-1}) and zinc (1.05 mg l^{-1}), was found in *Salviae folium* tea, while *Equiseti herba* tea contained more iron (0.135 mg l^{-1}), potassium (1067 mg l^{-1}), magnesium (152.6 mg l^{-1}) and sodium (4.53 mg l^{-1}) then other teas.

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Table 1

Element content of plant drugs and ± standard deviation [mg kg^{-1}]

Elements	*Equiseti herba* (n=5)	*Myrtilli folium* (n=3)	*Salviae folium* (n=4)
Al	188.4 ± 141.2	759.2 ± 180.3	965.8 ± 126.6
B	26.48 ± 4.43	52.44 ± 1.36	36.95 ± 12.41
Ba	18.34 ± 3.26	49.56 ± 3.32	23.80 ± 10.49
Ca	21834 ± 2897	15540 ± 140	20333 ± 4364
Co	0.773 ± 0.985	<0.15	0.107 ± 0.187
Cr	0.915 ± 0.141	4.93 ± 0.21	2.95 ± 1.26
Cu	8.74 ± 3.07	5.48 ± 0.57	8.00 ± 1.76
Fe	231.2 ± 24.8	485.8 ± 113.2	956.8 ± 140.1
K	28201 ± 1651	8654 ± 172	23766 ± 7716
Li	0.214 ± 0.318	2.84 ± 2.41	<0.15
Mg	5634 ± 702	2454 ± 114	6075 ± 826
Mn	97.02 ± 32.55	114.8 ± 1.86	50.84 ± 2.70
Mo	0.122 ± 0.032	0.337 ± 0.039	1.100 ± 0.356
Na	408.7 ± 266.2	85.4 ± 4.4	94.03 ± 87.21
Ni	22.07 ± 10.72	26.07 ± 3.45	<0.25
P	2346 ± 406	910 ± 24	1960 ± 494
S	16054 ± 326	1389 ± 91	2738 ± 593
Ti	3.58 ± 0.26	8.47 ± 3.21	3.12 ± 0.48
V	0.889 ± 1.065	0.558 ± 0.200	0.844 ± 0.090
Zn	26.56 ± 3.14	21.91 ± 0.48	33.26 ± 14.89

In nutritional aspect, good source of element contains at least 10% of the U.S. Recommended Dietary Allowances (RDA, 1989) in the selected serving amount. According to this the teas are good sources of calcium (RDA 800 mg/day/adult), potassium (RDA 2000 mg/day/adult), magnesium (RDA 350 mg/day/adult) and manganese (RDA 2–5 mg/day/adult). The dissolution of elements from plant drugs varies: highest dissolution was found for potassium (57.1–83.2%), magnesium (32.6–46.6%), boron (31.26–41.92%), sodium (26.2–79.8%) and phosphorus (25.02–49.83%). The highest calcium (27.7%), magnesium (46.6%), potassium (83.2%) and zinc (14.3%) was found in case of *Equiseti herba* and the best chromium (1.8%) dissolution was observed in case of *Myrtilli folium*.

According to phytochemical analysis the highest polyphenol content was observed for *Salviae folium* both in the drug (12.8%) and tea (3.6%) (Table 3). Extremely high amount of vitamin C was found for *Myrtilli folium* (470 mg%) and its tea (104 mg%).

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Table 2

Element concentration of teas, ± *standard deviation* (mg l^{-1}) *and the dissolution of elements in teas* (%) *in parenthesis*

Elements	*Equiseti herba* (n=3)	*Myrtilli folium* (n=3)	*Salviae folium* (n=3)
Al	0.36 ± 0.04 (2.82)	0.18 ± 0.02 (0.48)	1.51 ± 0.03 (3.54)
B	0.33 ± 0.01 (31.26)	0.92 ± 0.01 (34.88)	1.08 ± 0.24 (41.92)
Ba	0.21 ± 0.01 (18.96)	0.38 ± 0.05 (15.36)	0.27 ± 0.02 (14.92)
Ca	347.5 ± 3.5 (27.7)	90.5 ± 0.9 (11.59)	358.4 ± 2.9 (24.9)
Co	0.004 ± 0.002 (24.78)	<0.003	<0.003
Cr	<0.004	0.004 ± 0.001 (1.78)	<0.004
Cu	0.012 ± 0.001 (3.66)	0.024 ± 0.002 (7.66)	0.035 ± 0.003 (7.64)
Fe	0.135 ± 0.005 (1.32)	0.099 ± 0.008 (0.41)	0.12 ± 0.04 (2.36)
K	1067 ± 110 (83.2)	246.8 ± 15.3 (57.1)	654.5 ± 9.2 (57.3)
Li	<0.003	<0.0003	<0.003
Mg	152.6 ± 3.5 (46.6)	39.9 ± 0.3 (32.6)	146.6 ± 1.6 (40.8)
Mn	0.77 ± 0.02 (25.87)	0.68 ± 0.06 (18.01)	0.48 ± 0.05 (19.80)
Mo	<0.0005	<0.0005	<0.0005
Na	4.53 ± 0.011 (26.2)	1.45 ± 0.01 (33.9)	2.41 ± 0.08 (79.8)
Ni	<0.025	0.038 ± 0.002 (2.91)	<0.025
P	25.2 ± 0.2 (25.02)	11.93 ± 0.07 (26.20)	59.6 ± 0.8 (49.83)
S	8.26 ± 0.33 (1.01)	11.47 ± 0.07 (16.52)	70.60 ± 0.05 (41.53)
Ti	0.011 ± 0.001 (3.31)	0.001 ± 0.0001 (0.04)	0.044 ± 0.002 (2.38)
V	<0.0002	<0.0002	<0.0002
Zn	0.21 ± 0.02 (14.30)	<0.002	1.05 ± 0.01 (12.97)

Table 3

Polyphenol-, vitamin C-, ash- and crude material content of drugs and teas

Samples	Polyphenol content [mg%]	Vitamin C content [mg%]	Ash content [mg%]	Crude material content [g 100 ml^{-1}]
		Drugs		
Equiseti herba	1.40	50	0.3680	
Myrtilli folium	3.86	470	0.1419	
Salviae folium	12.8	–	1.4000	
		Extracts		
Tea of *Equiseti herba*	0.65	–		1.13
Tea of *Myrtilli folium*	1.26	104		1.97
Tea of *Salviae folium*	3.6	–		1.55

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3. Conclusions

The effect of medicinal drugs (extracts) cannot be attributed only to organic compounds (bioactive components) but probably to mineral elements as well (Ca, Mg, etc.), since during the preparation of extracts (tea) the presence of both organic (polyphenols, vitamins etc.) compounds and inorganic elements may be observed. Therefore, it is important to monitor the amount of elements in the drugs and their extracts. Of the medicinal plant drugs examined, *Salviae folium* is the richest in mineral elements and polyphenols. Regarding sage tea it seems to be the best from nutritional aspects. The tea does not contain enough metal-ion to cover our daily needs, nevertheless it may be important as supplementary food.

We think the dissolvable mineral elements (Cr, Mg, Zn, etc.) in herb teas may have an additional role in therapeutics. For example, the diuretic effect of potassium compounds has been known for some time, the fact, however, that this effect may also depend on the potassium to sodium ratio in teas has been reported only recently (SZENTMIHÁLYI et al., 1998). The potassium-sodium ratio in the teas of the drugs examined ranges from 170:1 to 272:1, which has a favourable diuretic effect. On the other hand, in an average diet, much more sodium than potassium is consumed, thus the ratio of sodium-potassium can be as high as 4:1 against the optimal ratio of 1:1 calculated from RDA (1989) (Recommended Dietary Allowances). An average diet contains calcium and magnesium in a ratio of 3:1, which is somewhat shifted to 2–2.5:1 for the aqueous extract.

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