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Short communications

MINERAL ELEMENT CONTENT OF CHAMOMILE

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Mineral components play an important role as adjuvants in the therapeutical activity of chamomile. Considering their content in the different species, an interesting observation was that the wild populations are richer in distribution of mineral elements than the cultivated Degumil type, while ratios of K/Na and Ca/Mg in this cultivated type are many times higher than in wild chamomile populations.

Chamomile tea extract (infusion) is widely used in digestion complains. Macro- and microelement content of the infusion is relatively low in which relatively high concentrations of potassium, calcium and magnesium were found. The dissolution of mineral elements in tea was between 10% and 26% for most of the elements with the highest value attributed to magnesium (26%).

Keywords: chamomile, mineral elements

The pharmacological effect of medicinal drugs or extracts cannot be attributed only to their bioactive components but to mineral elements as well, since the preparation of extracts (e.g. aqueous) results in the presence of both organic (flavonoids, sesquiterpenes, etc.) and inorganic compounds.

Chamomile, *Matricaria recutita* L. (Asteraceae) is important mostly for its antiphlogistic activity ((-)-α-bisabolol, chamazulene, etc.) (TUBARO et al., 1984) but occurrence of macro- and microelements in it contributes to its therapeutical activity and makes it of higher value. Mineral elements play an important role in physiological processes of living organisms.

Mineral elements absorbed and accumulated by plants are transported to the human organism by nutrition uptake. Zinc and manganese are indispensable for the activation of several enzymes in the metabolism of carbohydrates, fatty acids, proteins and nucleic acids. In many cases there is a competition between magnesium and manganese in enzymatic processes. During pregnancy magnesium supplement is needed, manganese is significant as a component in neurotic-, muscle- and cardiovasoprotective activities (FAZEKAS et al., 1994).

The drug of chamomile (*Chamomillae anthodium*) has been widely known and applied as a medicine for ages. Today the drug is officially registered in many Pharmacopoeias. In recent years controlled cultivation of chamomile has spread worldwide in preference to collection of the wild type.

An overall investigations of trace elements in terms of pharmacological activities has not yet been described. Previously some attempts were made in analysing the metallic trace elements in medicinal and aromatic plants (CHIZZOLA & FRANZ, 1996; JAIN et al., 1992; WONG et al., 1993). Elemental content of 20 medicinal plants used as tonic and for treatment of diabetes and sinusitis were detected by MAJID and co-workers (1995). Heavy metals contamination of medicinal plants, including *Matricaria*, has also been described (DE PASQUALE et al., 1993). Other mineral elements of chamomile have not been investigated so far, the distribution of macro- and microelements of Roman chamomile (*Anthemis nobilis*) was only reported among other Asteraceae plants (TÖLGYESI, 1969).

K/Na ratio in decoctions of diuretical drugs is higher than that of other drugs such as chamomile for example (SZENTMIHÁLYI et al., 1998). Significance of herbal teas can be connected also with trace element content.

1. Materials and methods

Plants under investigation were *Matricaria recutita* L., 3 wild chamomile populations from the area of Szabadkígyós, Hortobágy and Szeghalom, also Degumil, a cultivated type from Rózsahegyi Ltd. Kerepes, obtained in June 1997. Mineral element content of their inflorescence was examined, in addition the herb (shoot without inflorescence), root and the infusion from inflorescence of the cultivated Degumil were investigated.

1.1. Investigation of element content

For determination of macro- and microelement content of pulverized, dried drugs, atomic-emission spectrometry was used.

1.1.1. Sampling. Five hundred mg of each drug sample was measured into teflon vessels, then samples were smashed to pieces by the mixture of 5 cm^3 of cc. HNO_3 and 3 cm^3 of 30% H_2O_2 at 100 °C for 30 min. Samples exposed were washed into test-tubes of 25 cm^3 which were made up to the sign with distilled water. For determination of macroelements concentration 10-fold diluted solutions were made.

In case of infusion, after condensing it the sampling was carried out in the same way.

1.1.2. Determination of metal ion composition and quantity by an inductively coupled plasma atomic emission spectrometer (ICP-AES): quantity of the following 22 elements was examined: Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Na, Ni, P, Pb, S, Ti, V, Zn. For standardization of the apparatus, Merck ICP standards of similar composition and matrix as sample solutions were used. Three exact calibrations with 3-second-integration time, background correction and blank substraction were applied. Spectrometer: Thermo Jarrell Ash type Atom Scan 25 ICP with generator (2 kW; 27.12 MHz) exciting argon plasma to 8000–10000 °K. Optical system is composed of a Czerny-Turner vacuum monochromator and two fotoelectron multipliers.

1.2. Preparation of infusion

Hot water of 100 °C was poured on 2 g of drug and examined after cooling (PHARMACOPOEA HUNGARICA, 1992).

1.3. Statistical analysis

Means and standards were calculated from three parallel measurements.

1.3.1. One way analysis of variance (ANOVA) was used for comparison of means. The variability between data points was divided into variability between groups (columns) and variability within groups (residual, presumed to be random).

2. Results and discussion

The element concentrations show significant difference in the inflorescences of various chamomile populations. According to the ANOVA test, except for the cadmium and molibdene elements, the difference between the samples for other elements is highly significant ($P<0.0001$). Tables 1 and 2 indicate that the wild populations are richer in distribution of mineral elements than the cultivated Degumil type. The highest amount of aluminium, barium, copper, iron, magnesium, manganese, nickel, titanium, vanadium and zinc make up the population from Hortobágy among the elements investigated. It can be probably connected with the very salt-affected field occurring in that area. Sodium and potassium elements occur in biggest quantity in species from Szabadkígyós. The potassium content was many times higher than sodium content in all inflorescence measurements similarly to herbs and roots examined. The same tendency was observed for calcium in terms of magnesium. Comparing the plant parts of Degumil it was found that sodium content in herbs and roots showed a two-fold increase while potassium content was half than that of the inflorescence. It is known that potassium and sodium as well as calcium and magnesium have antagonistic effects and they depend on each other (HALPERN & DURLACH, 1996), that is why the ratios of these components were also investigated. It was remarkable that the ratios of K/Na and Ca/Mg in the inflorescence of the cultivated Degumil chamomile exceeded that of wild populations (Fig. 1a, b) which correlates with previous investigations (SZENTMIHÁLYI et al., 1998).

Table 1

Distribution of mineral elements (mg kg^{-1}) *in the inflorescences of wild chamomiles*

Elements	Element content ± S.D. (mg kg^{-1})		
	Chamomile inflorescences		
	Szabadkígyós	Hortobágy	Szeghalom
Al	251.20 ± 5.80	6173 ± 133	178.5 ± 4.6
As	<d.l. 6.73	±0.95	<d.l.
B	35.31 ± 1.32	23.24 ± 0.52	30.33 ± 1.13
Ba	5.85 ± 0.06	34.77 ± 0.60	5.81 ± 0.09
Ca	7419 ± 65	8023 ± 180	8386 ± 119
Cd	0.18 ± 0.07	<d.l.	0.28 ± 0.15
Co	<d.l.	2.67 ± 0.10	<d.l.
Cr	<d.l.	7.08 ± 0.16	0.44 ± 0.21
Cu	11.61 ± 0.04	14.95 ± 0.41	10.69 ± 0.42
Fe	367.10 ± 9.20	7574 ± 14	211.30 ± 1.90
K	30176 ± 320	22667 ± 529	28231 ± 739
Li	<d.l.	0.30 ± 0.20	<d.l.
Mg	3598 ± 14	3680 ± 55	2824 ± 51
Mn	62.44 ± 1.38	2397 ± 5	30.73 ± 0.37
Na	4088 ± 116	1260 ± 26	2729 ± 41
Ni	9.97 ± 0.87	11.88 ± 0.79	5.76 ± 0.46
P	4739 ± 65	3985 ± 69	5100 ± 126
Pb	<d.l.	6.76 ± 1.97	<d.l.
S	3302 ± 71	2566 ± 60	2842 ± 9
Ti	10.52 ± 2.11	28.10 ± 1.24	1.51 ± 0.04
V	0.39 ± 0.17	10.57 ± 0.28	0.23 ± 0.20
Zn	20.09 ± 0.90	44.87 ± 0.63	27.91 ± 0.51

<d.l. means below detection limit

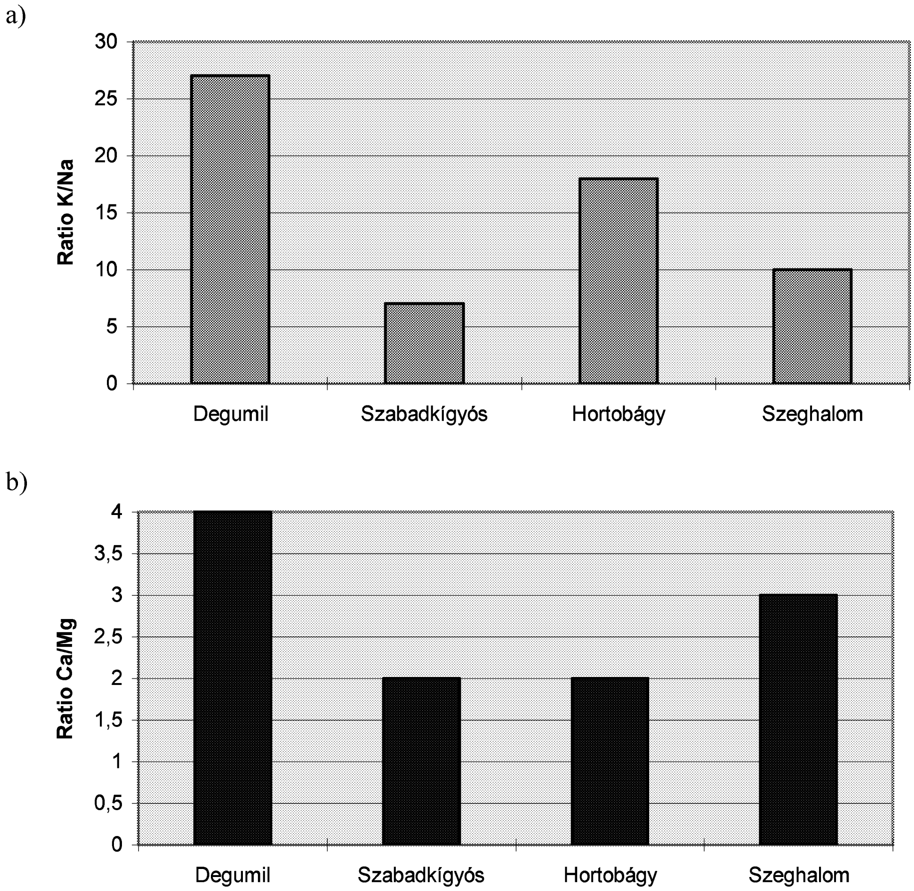

Fig. 1.a. K/Na ratio in the inflorescences of the cultivated and wild chamomiles b. Ca/Mg ratio in the inflorescences of the cultivated and wild chamomiles

This fact led us to investigate the mineral element content of infusion made from the inflorescence of this cultivated Degumil type. Macro- and microelement content of the infusion is relatively low in which relatively high concentration of potassium, calcium and magnesium were found (Table 2). The dissolution of aluminium, boron and potassium was above 10%, of barium, calcium, manganese and sodium between 15–20%, and the highest value was attributed to magnesium (26%).

Table 2

Distribution of mineral elements (mg kg^{-1}) *in different plant parts and in the infusion of the Degumil inflorescence* (mg l^{-1}) *and their dissolution* (%) *in it*

Elements	Root (mg kg^{-1})	Herb (mg kg^{-1})	Inflorescence (mg kg^{-1})	Infusion (mg l^{-1})	Dissolution (%)
Al	2263 ± 10	150.60 ± 2.90	217.5 ± 2.8	0.47 ± 0.17	10.8
As	7.09 ± 2.46	1.93 ± 0.14	<d.l.	<d.l.	<d.l.
B	21.17 ± 0.26	20.54 ± 0.25	38.70 ± 0.95	0.09 ± 0.02	11.9
Ba	15.98 ± 0.12	4.89 ± 0.13	2.56 ± 0.04	0.01 ± 0.01	15.6
Ca	9127 ± 95	9795 ± 70	10764 ± 131	39.13 ± 0.61	18.2
Cd	0.20 ± 0.05	0.22 ± 0.01	0.23 ± 0.11	<d.l.	<d.l.
Co	1.07 ± 0.05	<d.l.	<d.l.	<d.l.	<d.l.
Cr	2.05 ± 0.06	<d.l.	0.53 ± 0.04	0.001 ± 0.001	8.6
Cu	6.91 ± 0.22	3.45 ± 0.15	10.10 ± 0.59	0.006 ± 0.001	3.1
Fe	1813 ± 4	127.30 ± 0.97	179.50 ± 1.66	4 ± 0.1	1.1
K	12304 ± 174	11445 ± 94	25847 ± 428	73.28 ± 4.06	14.2
Li	1.43 ± 0.23	<d.l.	<d.l.	<d.l.	<d.l.
Mg	1736 ± 6	1709 ± 22	2847 ± 15	14.87 ± 0.30	26.1
Mn	70.99 ± 0.15	19.13 ± 0.14	30.92 ± 0.49	0.11 ± 0.01	17.3
Na	1626 ± 24	1531 ± 26	951.30 ± 14.80	3.00 ± 0.11	15.8
Ni	2.62 ± 0.12	1.49 ± 0.08	1.64 ± 0.54	<d.l.	<d.l.
P	1219 ± 6	1185 ± 10	4719 ± 80	2.50 ± 0.22	2.7
Pb	3.64 ± 0.21	2.50 ± 0.17	<d.l.	<d.l.	<d.l.
S	1831 ± 10	1842 ± 22	3387 ± 20	5.87 ± 0.06	8.7
Ti	61.05 ± 1.52	3.53 ± 0.17	2.02 ± 0.05	0.001 ± 0.001	2.9
V	3.44 ± 0.14	<d.l.	<d.l.	<d.l.	<d.l.
Zn	23.03 ± 0.61	11.37 ± 0.26	40.10 ± 0.22	0.07 ± 0.07	9.0

<d.l. means below detection limit

Even if the tea extract contains the mineral elements in lower quantity than the drug itself, consuming one litre of tea suits a part of some elements' requirements of their daily dose (RDA, 1989), for example some cups of tea supplement a part of the daily dose of magnesium which is particularly needed for women during pregnancy.

3. Conclusions

Occurrence of macro- and microelements in chamomile species attribute to their therapeutical activity and make them of higher value.

The majority of the mineral elements were found in highest amount in the inflorescences of wild chamomile species which can be attributed to the salt-affected fields of those areas, while ratios of K/Na and Ca/Mg in the cultivated type are many times higher than in wild chamomile populations.

Chamomile tea extract (infusion) is widely used. The dissolution of mineral elements in tea was between 10% and 26% for most of the elements investigated and only a small change of K/Na ratio could be detected during dissolution.

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