EVALUATION OF SOME ESSENTIAL MINERAL ELEMENTS FROM DIFFERENT INFUSIONS OF MEDICINAL PLANTS

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Abstract. *Since ancient times, herbal tea is one of the most consumed beverage around the world, after water. Traditional medicinal plants are used to obtain a wide variety of tea types, with beneficial effects on the nutritional and health status of the population. Herbal teas obtained from medicinal plants, depending on the type of plant used for preparation, have multiple therapeutic properties. They can be consumed both in the form of infusions, decoctions and macerated like food or as a natural remedy for many varieties of diseases. The paper describes four common medicinal plants: chamomile (Matricaria chamomilla), peppermint (Mentha x piperita), hypericum (Hypericum perforatum) and linden (Tilia x europaea) with their physicochemical and therapeutical properties, the way of preparation and administration, also literature data of some macro and microelements content in some herbal teas and their infusions. The main purpose of this study is to determine the concentration of some essential mineral elements from some herbal infusions used more frequently in the preparation of medicinal teas: mint (Mentha x piperita), chamomile (Matricaria chamomilla), hypericum (Hypericum perforatum) and linden flowers (Tilia x europea). The concentrations of six bioelements were determined by atomic absorption spectrometry in the acetylene flame: Ca, Mg, Fe, Mn, Zn and Cu. The obtained results show that the analyzed tea infusions contain significant amounts of Ca (6.20 - 12.29 mg / 200 ml) and Mg (1.77 - 2.69 mg / 200 ml) and appreciable Fe (32.72 - 52.02 μg / 200ml), Mn (64.07 - 88.12 μg / 200 ml), Zn (16.67 - 93.80 μg / 200 ml) and Cu (8.75 - 21.91 μg / 200 ml). The results obtained for the evaluation the mineral intake of tea infusions, in the conditions of the present experiment, show that the degree of coverage of the daily mineral requirement, corresponding to a daily consumption of 400 ml of tea, shows low values between: 1.20 - 2.46% - for Ca, 0.86 - 1.70% - for Mg, 0.36 - 1.74% - for Fe, 5.57 - 9.79% - for Mn, 0.30 - 2.34% - for Zn and 1.94 - 4.86% - for Cu. Therefore, these teas cannot be considered as additional sources of essential elements.*

Keywords*: medicinal plants, herbal infusions, esential element, mineral intake*

INTRODUCTION

The medicinal use of herbs and other parts of plants has been frequently used throughout history within each culture, for treatment and prevention of diseases and also, health promotion. The different type of herbs is known and widely used for their diversified assortment of herbal teas**,** with therapeutic properties on the human health and nutrition. Herbal tea is the second most consumed beverage in the world after water, due to its many health benefits, good taste and pleasant aroma. In the form of infusions, decoction and maceration, they can be consumed either as food or as a natural treatment for many varieties of diseases (JOHNSON, R., ET ALL, 2012; BENZIE, I., WACHTEL-GALOR, S., 2011; CHEVALLIER, A., 2000).

The beneficial effects of herbal teas are due to bioactive substances, such as alkaloids, tannins, organic acids and essential oils, vitamins, etc. and last but not least due to the mineral

elements. In addition to the bioactive compounds, herbs also contain considerable amounts of mineral bioelements with beneficial impact on the body's function.

In the composition of some herbal teas there are a series of macro and microelements such as: Na, K, Ca, Mg, P, S, N etc., respectively Fe, Cu, Mn, Zn, I, Se, etc., some of them essential for good development of human body (PYTLAKOWSKA, K. ET ALL, 2012; SULIBURSKA, J. ET ALL, 2012; GENTSCHEVA, G.D. ET ALL, 2010; KOSTIC, D. ET ALL., 2011).

The amount of mineral elements in plant, depends on the culture conditions (including soil composition and fertilization), environmental pollution and technological processes applied to the raw material. When we use medicinal herbs for culinary and therapeutic purposes, we absorb certain amounts of minerals from these products. (BASGEL, V. ET ALL, 2006, STREET, R. ET ALL, 2006).

A proper balance of mineral elements in our diet is an essential factor that influences, the development and proper functioning of the body. Macro and microelements are not completely extracted from the plant by infusion, extraction rates depend on the type of element to be taken into account. The amount of minerals from the infusions depends on the efficiency of constituent extraction under tea-making conditions, as well as the total concentrations of the elements of the medicinal plants. (PYTLAKOWSKA, K. ET ALL, 2012; VELCIOV, A., ET ALL, 2015)

The data reported in the literature show that the plants used for the preparation of medicinal teas contain increased quantities of mineral elements, essential for the proper functioning of the human body. Calcium and magnesium are known for their structural roles, which are essential for the development and maintenance of bones and teeth, also for maintaining cell membranes and tissue. (SOETAN, K.O. ET ALL., 2010). Iron is an essential element with an important role in oxygen transport while manganese, zinc and copper acts as an activator or stabilizers of many enzymes. (MEHRI A., 2020, SOETAN, K.O. ET ALL., 2010) Thus, it is important to evaluate the mineral profile of the infusions of these medicinal plants, used for comforting and therapeutic purposes.

The present study aims to determine some essential mineral elements from four infusions of tea plants most frequently used for the preparation of medicinal teas: mint (*Mentha* x *piperita*), chamomile (*Matricaria chamomilla*), St. John's wort (*Hypericum perforatum*) and linden flowers (*Tilia x europaea*). The concentrations of six bioelements were determined by atomic absorption spectrometry in the acetylene flame: Ca, Mg, Fe, Mn, Zn and Cu. The obtained results allowed the evaluation of the mineral intake, the coverage degree of daily requirement of Ca, Mg, Fe, Mn, Zn and Cu, corresponding to a proper consumption of tea infusions.

MATERIAL AND METHODS

To perform the experiment four types of herbal teas were purchased from health food stores in Timișoara, most commonly used for making tea infusions: mint (*Mentha x piperita*), chamomile (*Matricaria chamomilla*), St. John's wort (*Hypericum perforatum*) and linden flowers (*Tilia x europaea*). The analyzed teas were presented in the form of sachets packaged, by the manufacturer, in carton boxes.

The device used for this purpose was Atomic absorption spectrophotometer in air flame - acetylene, brand Varian AA 240 FS, a laboratory water bath and a thermal regulation electric stove. Also, the Reagents used are Nitric acid Merck, 65% (ρ = 1.39 g/cm^3) to prepare the nitric acid solution 0.5 N; standard solutions for the analysed elements: Ca, Mg, Fe, Mn, Zn and Cu, obtained from the concentrated standard solution Merck Darmstadt - Germany, 1.000

g/ml; for each analysed element were prepared six sets of standard solutions to cover the concentration range of each element analysed; distilled water.

Preparation of tea infusions was made according to the tea manufacturer's instructions for each type of product. Thus, in Berzelius glasses of 250 ml, the contents of a tea bag were introduced (about 1.5- 1.8g, depending on the type of analysed tea) over which, were added 200 ml of boiling distilled water. After about 10 minutes, the infusion was filtered through filter paper and it was filled with distilled water up to the mark of 200 ml.

Determination of mineral elements from the analysed tea infusions required two steps: complete solubilisation of the mineral substances in infusions and measuring the absorption of the analysed elements using the atomic absorption spectrophotometer. (GOGOASA, I. ET ALL, 2013, VELCIOV, A., ET ALL., 2015). For the complete solubilization of the mineral elements from tea infusions, they have evaporated on a water bath to a volume of about 20-30 ml, after which the infusion samples were treated with 20 ml of 0.5N HNO_3 nitric acid and evaporated to dryness. This operation was repeated two more times, after which the contents were brought up to 50 ml. These final solutions were used to determine the mineral elements.

Measuring the absorbance of the mineral elements was determined by atomic absorption spectrometry in the air-acetylene flame directly from the solution brought to the quota of 50 ml at the wavelength characteristic of each analyzed element. The working parameters of the apparatus – wave length, air and acetylene pressure, burner height, etc. – were selected in accordance with the recommendations of the Varian AA 240 FS. Simultaneously with the measurement of the absorbance of analyzed samples, the absorbance of the working standards solutions were determined in the same working conditions.

The concentration of mineral elements in tea infusions was calculated with the relation:

$$c\left[mg/200ml\right]=\frac{a}{4}\cdot 1000$$

where: a - the concentration of the analyzed element indicate by the device (mg/ml).

RESULTS AND DISCUSSIONS

To estimate the mineral intake of the analyzed tea infusions, were taken into account Ca, Mg, Fe, Mn, Zn and Cu concentrations in 200 ml tea infusion (Table 1) based on, it was calculated, the amount of each element contained in 400 mL and the recommended daily intake in „Dietary Reference Intakes (DRIs): Recommended Dietary Allowances and Adequate Intakes, Elements Food and Nutrition Board, National Academies”

Table 1

The necessary reference values of Ca, Mg, Fe, Mn, Zn and Cu, in the recommended daily diet, for men and women aged between 19 and 50 years

Group of people	Element, mg/day					
	Ca	Mg	Fe	Mn	Zn	Cu
Men	1000	400	8	2,3	11	0,9
Woman	1000	320	18	1,8	8	0,9

Mineral intake in the recommended daily diet, corresponding to each mineral element, was calculated using the relation:

$$M\ I(\%) = \frac{m_{\text{inf}}}{m_{rec}} \cdot 100$$

where: MI – mineral intake (%); m_{inf} - mass of element present in 400 mL tea infusion; m_{rec} - the recommended mass of the element in the daily diet.

The experimental results obtained in the determination of mineral elements from the analyzed tea infusions, expressed in mg/200 grams are presented in Table 2.

Table 2

The concentration of Ca Mg, Fe Mn, Zn and Cu (mean values) from some infusion of medicinal plants

Herb samples	Element, mg/200 ml		Element, µg/200 ml			
	Ca	Mg	Fe	Mn	Zn	Cu
Peppermint *(Mentha x piperita)*	8.9923± 0.53	2.6916± 0.38	38.54± 0.99	64.07± 1.07	25.20± 0.77	10.43± 0.60
Chamomile *(Matricaria chamomilla)*	6.1977± 0.38	2.1704± 0.23	52.02± 1.27	77.11± 1.39	33.76± 0.64	21.91± 0.72
Hypericum *(Hypericum perforatum)*	6.9693± 0.67	1.7676± 0.27	32.72± 0.61	72.71± 1.14	93.8± 1.61	8.75± 0.48
Linden flowers *(Tilia x europaea)*	12.2879± 0.81	2.473± 0.22	46.47± 0.84	88.12± 3.5	16.67± 0.57	8.87± 0.66

As can be seen from Table 2, the concentration of essential mineral elements in the analyzed tea infusions is non-uniform, with values between 8.75 µg Cu/200 ml (in hypericum) and 12.29 mg Ca/200ml (in linden flowers)**.**

The distribution of the mineral elements in tea infusions taken in the experiment is dependent on the type of tea used to prepare infusion and also on the nature of the analyzed bio-element. (DUCAT, G., ET ALL, 2011; PYTLAKOWSKA, K., ET ALL, 2012)

The best represented elements are the macro-elements calcium and magnesium which has the highest concentration values between 12.2879 – 6.1977 mg/200 ml Ca, respectively 2.6916 – 1.7676 mg/200 ml Mg.

Regarding the distribution of microelements of tea infusions taken in the experiment, they are present in much lower concentrations. Zinc has been determined in lower concentrations than Mn and Fe, which was identified in the range between 16.67 µg/200 ml (in linden tea infusion) and 93.80 µg/200 ml (in St. John's wort infusion). Copper is the element that has been determined in the lowest concentrations of all the analyzed elements, between 21.91 – 8.75 µg/200 ml.

The average concentrations of microelements in the analyzed tea infusions show the following decreasing trend: Mn>Fe>Zn>Cu.

The results obtained in determining the mineral intake, in the recommended daily diet, under the experimental conditions described above, are presented in tables 3 and 4.

Table 3

Mineral intake in the recommended daily diet for men, corresponding to a consumption of 400 ml of tea infusion

Tea infusion	Mineral element (%)					
	Ca	Mg	Fe	Mn	Zn	Cu
Peppermint	1.80	1.31	0.96	5.57	0.46	2.32
Chamomile	1.20	1.06	1.30	6.70	0.61	4.86
Hypericum	1.39	0.86	0.82	6.32	2.56	1.94
Linden flowers	2.46	1.20	1.74	7.66	0.30	1.97

Table 4

Mineral intake in the recommended daily diet for women, corresponding to a consumption of 400 ml tea infusion

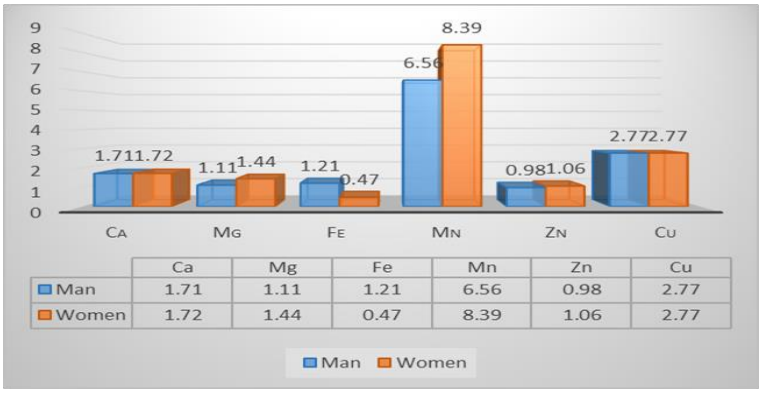
Tea infusion	Mineral element (%)					
	Ca	Mg	Fe	Mn	Zn	Cu
Peppermint	1.80	1.70	0.42	7.12	0.62	2.32
Chamomile	1.24	1.38	0.58	8.56	0.84	4.86
Hypericum	1.39	1.12	0.36	8.08	2.34	1.94
Linden flowers	2.46	1.57	0.51	9.79	0.42	1.97

As can be seen from Tables 3 to 4, in the context of the present experiment, not all elements contribute differently to the mineral requirement of the daily diet. It can be seen that the mineral intake of the analyzed tea infusions has low values, between 1.20 % (Ca in chamomile - for men and women) and 9.79 % (Mn in linden flowers - for women).

Most appreciated in terms of mineral intake is manganese which has values between 5.57 % (in mint) - 7.66 % (in linden flowers), for men and 7.12 % (in mint) - 9.79 % (linden flowers) for women. With some minor exceptions (2.56 % Zn - for men and 2.34 % Zn for women in St. John's wort, respectively 1.74% and 1.30 % Fe in linden and chamomile - for men, in the analyzed infusions, zinc and iron have very low intakes. In case of copper slightly higher values, compared to Zn and Fe were determined (1.94 % in St. John's wort and 2.32 % in mint - for men and women) magnesium (0.86 - 1.31%, for men and 1.12 - 1.70 % for women) and calcium (1.40 - 2.46 %, for men and women).

The obtained results are in the range of values obtained by other authors in the analysis of similar tea infusions. (VELCIOV, A. ET ALL., 2015; SULIBURSKA, J., KAZMAREK, K., 2012; KOSTIC, D. ET ALL, 2011)

In general, the average mineral intake shows the following increasing trend: : Zn< Fe≅ Mg< Ca≅ Cu< Mn, for males and Fe≈ Zn< Mg≅ Ca≅ Cu<Mn, in case of females. (Figure 1)



	Ca	Mg	Fe	Mn	Zn	Cu
Man	1.71	1.11	1.21	6.56	0.98	2.77
Women	1.72	1.44	0.47	8.39	1.06	2.77

Figure 1. Mineral intake for men and women, corresponding to a consumption of 400 ml tea infusion prepared from a mixture of herbs

A systematization of tea infusions, depending on the values of their intake in mineral elements is quite relative, considering the non-uniformity distribution of elements in tea infusions and the recommended daily requirement. These results show that an average consumption of 400 ml of herbal infusions (two cups of tea a day) it is not important as a source of calcium, magnesium, iron, manganese, zinc and copper and cannot be considered as an additional source of essential elements. (SULIBURSKA, J., KAZMAREK, K., 2012)

A possible increase in mineral intake in the daily diet, would be possible by supplementing the mass of plant used to prepare the infusion, or by an increased consumption of tea infusion. In this case it should be borne in mind that inadequate, excessive consumption can lead to loading the body with some minerals or other food principles, with harmful side effects. (SCHWALFENBERG, G., ET ALL, 2013; RUBIO, C., ET ALL, 2012).

Therefore, it is absolutely essential to have good control of the plants used in the preparation of various medicinal teas, not only to know the concentration of essential elements, but also to avoid excess or cumulative effects due to the various constituents present in infusions.

CONCLUSIONS

The analyzed herbal tea infusions contain significant amounts of: Ca, Mg and appreciable values of: Fe, Mn, Zn and Cu.

The distribution of mineral elements in the analyzed tea infusions is uneven, their concentration having values between 8.75 μg Cu/200 ml (in hypericum) and 12.29 mg Ca/200ml (in linden flowers).

The best represented of the analyzed mineral elements are calcium and magnesium. Iron, manganese, zinc and copper have been identified in much lower concentrations.

The concentration of mineral elements in the analyzed herbal teas presents the following ascending trend: Mg <Ca, respectively: Cu <Zn <Fe <Mn.

The results obtained in the estimation of mineral intake points out that the mineral elements analyzed contribute differently to the mineral requirement of the daily diet, depend on the type of tea, consumer and the nature of the essential element.

The most appreciated in terms of mineral intake is manganese. Lower values were determined for copper, magnesium and calcium.

The lowest levels of mineral intake, with some exceptions, were identified for zinc and iron. In general, the average mineral intake shows the following increasing trend: Zn< Fe≅ Mg< Ca≅ Cu< Mn, for males and: Fe≈ Zn< Mg≅ Ca≅ Cu<Mn, in case of the females.

An average consumption of 400 ml of the infusion of these herbs (two cups of tea per day) cannot be considered as an additional source of Ca, Mg, Fe, Mn, Zn and Cu.

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