THE EVALUATION OF SOME BIOELEMENTS IN DIFFERENT TYPES OF HERBAL TEAS

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Abstract. *Herbal teas are a popular beverage and are used as therapeutic vehicles in many forms of traditional medicine. As tea is a popular drink and its preparation is remarkably simple (pour hot water on various dry herbs), it is very important to monitor and develop a screening methodology for detecting metals content in herbal tea. The number of articles exploring the efficacy and clinical safety of teas and herbal teas is small, even though herbal materials are the basis of the discovery of medicines and teas are some of the most popular drinks. This research was aimed to estimate the distribution of some bioelements in different types of herbal teas used in diet therapy. We used atomic absorption spectrometry in order to determine the concentration of Ca, Mg (macroelements), Mn, Fe, Zn and Cu (trance elements) in various indigenous herbal teas. In our work we collected herbal teas from county Gorj. These herbals are chamomile (Matricaria chamomilla), peppermint (Mentha piperita), marigold (Calendula officinalis), yarrow (Achillea millefolium), and Plantain (Plantago lanceolata). Preliminary results of this study reveal an uneven distribution of the concentrations of these bioelements. Bioelements distribution in analysed herbal teas presents generally, the following trend: Ca > Mg > Fe > Mn > Zn > Cu. The study aimed at the determination of the mineral composition of medicinal herbs for evaluation of the coverage of the recommended daily intake of mineral elements by tea. The concentration of these bio-elements in herbal teas shows significant variations determined by the nature and type of herbal tea and bio-elements investigated.*

Keywords*: biominerals, atomic absorption spectrometry, herbs, herbal tea*

INTRODUCTION

Romania is a European country with a rich diversity of plants due to climatic conditions and geographical position (in South East of the continent). Tea is one of the most popular beverages in Romania and in the world. Tea was first consumed in China (about 5,000 years ago) for its medicinal properties. In the present age, tea has been widely recognized for its health benefits in raising public awareness of the high content of biologically active compounds (such as flavonoids, polyphenols, vitamins, minerals, etc.) in medicinal plants and extracts of medicinal herbs (MESBAUL ALAM ET AL., 2020). Nowadays, tea consumption is part of people's daily routine, as a daily drink and as a therapeutic remedy in many diseases. Herbal teas are used as therapeutic vehicles in many forms of traditional medicine. The use of plants for the treatment of diseases is closely related to human evolution, in all strata and social periods. The use of medicinal herbs and phytotherapy is part of popular (folk) medicine, which is based on the knowledge of different users, populations, and professionals.

Medicinal plants are known for their large variety of herbal teas with particularly beneficial effects on nutrition and health. The beneficial effects of teas are due to the diversity of biologically active compounds that are part of the composition of medicinal plants. Among the biologically active substances are polyphenols, flavonoid compounds, tannins, vitamins, oils, flavors, alkaloids, etc. (SLIBURSKA AND KACZMAREK, 2012; PYTLAKOWSKA ET AL., 2012).

Medicinal herbal, plants and plant compounds (such as biologically active compounds, minerals, etc.) have contributed and continue to contribute to the development of

new therapeutic strategies. These strategies are based on the identification and isolation of various secondary metabolites and macro and microelements, which have a direct or indirect action through various molecular and cellular mechanisms. (DE ARAGÃO TANNUS ET AL., 2021) (PETROVSKA, 2012)

The diversity of these biologically active components means that herbal teas are used for various therapeutic purposes – prevention and cure of many diseases: calming, improving digestive status, increasing energy levels and invigorating the body, preventing colds, internal stimulation. organ functioning, stress reduction, body detoxification, source of antioxidants, increased immunity, etc. (NOOKABKAEW ET AL., 2006; DUCAT ET AL., 2012, DE ARAGÃO TANNUS ET AL., 2021).

Along with the active compounds (with pharmacological activity), the medicinal plans contain various mineral bio-elements in remarkable quantities. (GENTSCHEVA , ET AL., 2010; KOSTIĆ ET AL., 2011; SLIBURSKA AND KACZMAREK, 2012; PYTLAKOWSKA ET AL., 2012; MESBAUL ALAM ET AL., 2020) Minerals have beneficial effects on the activities of the body.

Minerals are of unique and diversified importance to both plants and living (human) beings. In plants, mineral elements are found as ions, organic and inorganic salts, or are accumulated into various organic compounds (PETROVSKA, 2012). According to their proportional ratio in plant composition, minerals are classified into macro, micro and ultra microelements.. The content of minerals elements in plants can have vary significantly.

The content in heavy metals helps us to determine the pollution of the environment. Metals such as Fe, Zn, Cu, Co and Cr are essential nutrients for plants, presenting toxic character only in high concentrations. Heavy metals such as cadmium (Cd), lead (Pb), and mercury (Hg) are toxic metals with no functional role in metabolism (FAO/WHO, 2011). One of the most serious environmental concerns is the accumulation of heavy metals in plants. This is because plants can transfer pollutants (toxic heavy metals) from the soil into the food chain (soil –> plant –> food) causing adverse effects on human health (BADEA, 2015).

This research was aimed to estimate the distribution of some bioelements in different types of herbal teas used in diet therapy. We used atomic absorption spectrometry in order to determine the concentration of Ca, Mg (macroelements), Mn, Fe, Zn and Cu (trance elements) in various indigenous herbal teas. In our work we collected herbal teas from county Gorj. These herbals are chamomile *(Matricaria chamomilla),* peppermint *(Mentha piperita),* marigold *(Calendula officinalis),* yarrow *(Achillea millefolium), and* Plantain (*Plantago lanceolata).* The study aimed at the determination of the mineral composition of medicinal herbs for evaluation of the coverage of the recommended daily intake of mineral elements by tea.

MATERIAL AND METHODS

Collection and preparation of herbal samples. In this work we used herbal teas were collected from county Gorj. These medicinal herbals used in our research are shown in table 1.

The samples were transferred to our laboratory after harvest. The plants were selected according to uniformity of shape and color, and then were then dried at 25-55^{0}C and stored in paper bags at 20 °C until analysis. After washing, the plants were dried in a shady place and then were transformed into powdered. The materials in the form of powders were used in the analysis.

Table 1

Herbal medicinal plants used in research

	Sample abbreviation	Plant	The Latin name of the plant (family)	Parts of plants with medicinal properties used in research
1	**MC**	Chamomile	*Matricaria chamomilla*	Flowers
2	**MP**	Peppermint	*Mentha piperita*	Leaves and stems with leaves and flowers
3	**CO**	Marigold	*Calendula officinalis*	Flowers
4	**AM**	Yarrow	*Achillea millefolium*	Flowers
5	**PL**	Plantain	*Plantago lanceolata*	leaves

Reagents and Apparatus. In this study we used reagents were purchased from Merck (Germany). Aqueous standard solutions of Ca, Mg, Fe, Mn, Zn, and Cu were prepared by appropriate dilution of 1,000 gL-1 stock solutions (Merck Darmstadt, Germany). We used HNO_3 (65%) and hydrogen peroxide H_2O_2 (25%) to disaggregate the samples.

For determination of the concentration of mineral bioelements in herbs used spectrophotometer (air-acetylene flow) CONTR AA 300 endowed with a soft. The digestion was done in system 6-1007 Digester (provided by Tecator).

Determination of total concentration of elements in herbs. The determination of the biomineral composition in herbal teas occurred in several stages: dried and homogenized samples, mineralising and digestions herbal teas in nitric acid (65%) hydrogen peroxide H_2O_2 (25%) at 150ºC and determining mineral absorbance through spectrophotometry. We were used system 6-1007 Digester (provided by Tecator). In the next steps, the samples solution was filtered and brought to constant volume (50 mL) with deionized bidistilled water, and then, submitted for analysis. The absorbance of the sample was measured by atomic absorbance spectroscopy.

Statistical analysis. Each determination was performed three times (in triplicate), then were calculated the arithmetic mean of these three separate determinations. For statistical analysis of the data were used the program Microsoft Excel.

RESULTS AND DISCUSSIONS

Tea consumption is part of people's daily routine, as a daily drink and as a therapeutic remedy in many diseases. The use of plants for the treatment of diseases is closely related to human evolution, in all strata and social periods. Phytotherapy (the use of medicinal herbs) is part of popular medicine, which is based on the knowledge of different users, populations, and professionals. In Oltenia region, plants are used for different diseases. The choice of the plants studied was based on data on the use of teas in traditional medicine in various diseases. These data have been collected from the locals over time.

Below are some of the conditions that can be treated or alleviated using various teas. Table 2 schematically presents these remedies.

Chamomile (*Matricaria chamomilla*) is popularly called the plant of Heaven, it cures suffering of any kind. It is used for any disease. This tea is used as a remedy for colic in babies. It is also used as a sedative for the stomach, especially in the case of gastritis. Externally, it is used in the form of hot or cold compresses (on wounds, conjunctivitis on the eyes).

Peppermint (*Mentha piperita*) is used to relieve many digestive problems. Peppermint tea can have beneficial effects on indigestion, diarrhea, nausea, bloating, and symptoms of irritable bowel syndrome.

Marigold (*Calendula officinalis*) is used both internally and externally. Externally treat rashes, lesions, vaginal infections and other skin conditions. In addition, marigolds can reduce pain and inflammation. Internally to heal wounds in the mouth, throat and digestive tract

Yarrow (*Achillea millefolium*) is used externally to heal wounds and burns. Tea is also used externally for acne. It is also used in gynecological treatments for women. Tea and tincture are used both internally and externally. Internally, by ingestion, Yarrow tea has the role of regulating menstrual flow.

Plantain (*Plantago lanceolata*) is used as an adjunct in the treatment of colds, flu and bronchitis.

Table 2

Medicinal plants - remedies used in folk practice

Plant *(The Latin name of the plant)*	**Remedies used in folk practice**
Chamomile *(Matricaria chamomilla)*	• for any kind of suffering • baby colic, hot or colds compresses • soothing for the stomach and gastritis
Peppermint *(Mentha piperitaÎ*	• benefits for the digestive system (indigestion, diarrhea, nausea, bloating and symptoms of irritable bowel syndrome)
Marigold *(Calendula officinalis)*	• External - treating rashes, lesions, vaginal infections and other skin conditions. • reduces pain and inflammation. • Internal - to heal wounds in the mouth, throat and digestive tract.
Yarrow *(Achillea millefolium)*	• External - gynecological treatments for women • Internal - Yarrow tea has the role of regulating menstrual flow
Plantain (*Plantago lanceolata*)	• Plantain leaves can be used externally • adjuvant for treating colds, flu and bronchitis.

The results of the analytical characterization of herbal teas of cations content are displayed in Table 3.

Table 3

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

Samples	**Biomineral contents**					
	Ca	**Mg**	**Cu**	**Zn**	**Mn**	**Fe**
	$g \cdot kg^{-1}$ dry weight		$mg \cdot kg^{-1}$ dry weight			
MC	10.21	3.32	18.70	71.32	52.79	115.39
MP	11.31	4.50	11.71	27.12	111.22	399.89
CO	8.10	4.01	25.01	50.12	83.09	588.21
AM	13.3	2.21	11.82	56.11	67.45	187.49
PL	13.31	2.98	9.13	27.89	145.04	54.79

Note: DW = dry weight of the sample (herbs)

Analysing our data from table 3 and figures 1 and 2, it can see that the distribution of macroelements in the studied medicinal herbs is randomly, having values with large variations, ranging between 2.21 g/kg (Mg, in Yarow AM) and 13.11 g/kg (Ca, in Plantain PL) depending on the species of plant and on the element analysed nature.

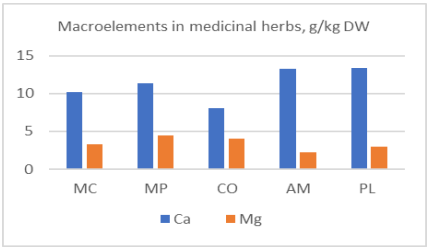

Fig. 1. Macroelements content in medicinal herbs

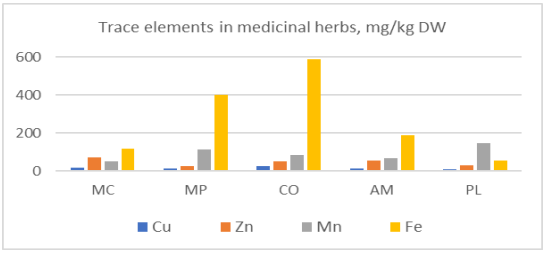

Fig. 2. Trace elements content in medicinal herbs

From table 3 and figure 1 and figure 2, it can see that the distribution of micro-bioelements in the studied medicinal herbs is random, having values with large variations, ranging between 9.13 mg/kg DW (Cu, in Plantain PL) and 588.21 mg/kg DW (Fe, in Marigold, CO).

The important bioelements represented are Ca and Mg in contents ranging between 8.10 and 13.31 g/kg and 2.21 and 4.5 g/kg DW, respectively. Values of the analyzed microelements concentrations were found to be much lower, thus for copper the concentration in the plant was in the range between 9.13 mg/kg and 25.01 mg/kg; for zinc, the concentration in the plant was in the range 27.12 - 71.32 mg/kg; for manganese, the concentration in the plant was in the range 52.79 – 145.04 mg/kg DW; for iron, the concentration in the plant was in the range 54.79 – 588.21 mg/kg DW.

These differences in our data are confirmed by data from the literature. In the literature the values of the total content of elements vary depending on the plant species, the nature of the minerals, as well as a set of factors such as climatic conditions and soil, storage mode, etc.

For medicinal plants MP, CO, AM the average concentration in bioelements increases from copper to iron as follows: Cu <Zn <Mn <Fe <Mg <Ca. For MC we have the following variation of the concentration in minerals Cu <Zn<Fe <Mn<Mg <Ca. Instead, for PL we have the following variation of the concentration in minerals Cu <Zn<Fe <Mn<Mg <Ca.

If we analyze the content of an element in different plants, we can see that in the case of calcium the highest content is in plantain– PL (with a value of 13.31 g/kg DW) varying in the series CO < MC < MP < AM <PL.

For all plants, the highest concentration is found in calcium, followed by magnesium.

This information on the metal content of medicinal plants provides only primary information. This primary information may also be accompanied by data on the minerals (macro and microelements) content of the soil from which these plants originate.

Also, to see what is the content of elements available to the body must be performed their extraction, ie/namely infusion of plants in water - teas. It is known that teas are drinks often used by the population of the globe. Teas bring the intake of macro and biolements to the human body.

Only minerals from infusions (teas) are available to the body. That is why in our next studies (further our studies) we will focus on the determination content of metals in infusions (teas) but also on the content of metals in the soil. Thus, the first step was to determine the content of elements in medicinal plants and then to determine the content of bioelements in infusions of these plants, which we are already working.

These studies are important to have an overview of the content of metals in plants and then to determine the extraction coefficient of each element of the plant in the aqueous infusion - tea.

Our data can be correlated with those in the literature. The concentrations of metals in medicinal plants are similar to those of the studies from literature, BASGEL AND ERDEMOGLU (2016), GENTSCHEVA and co-authors (2010), KOSTIĆ and co-authors (2011), DIACONU and co-authors (2012), PYTLAKOWSKA and co-authors (2012), VELCIOV and co-authors (2015), where the content of metals is approximately in the same concentration range. There are small differences from the data in the literature. The differences can be caused by the climatic conditions, the harvest period, the environmental conditions, etc.

CONCLUSIONS

These studies are important to have an overview of the content of metals in plants and then to determine the extraction coefficient of each element of the plant in the aqueous infusion - tea. Our experimental data are largely consistent with those in the literature. Differences can be caused by climatic conditions, harvest period, environmental conditions, etc.

For seeing what the content of elements is available to the body it is necessary to be performed their infusion of plants in hot water – teas. Teas bring the intake of macro and bio-elements to the human body.

Only minerals from infusions (teas) are available to the body. That is why in our next studies (further our studies) we will focus on the determination content of metals in infusions (teas). Thus, the first step was to determine the content of elements in medicinal plants and then to determine the content of bioelements in infusions of these plants.

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