RESEARCHES REGARDING PROXIMATE AND SELECTED ELEMENTS COMPOSITION OF SOME MEDICINAL PLANTS BELONGING TO THE LAMIACEAE FAMILY

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Abstract

Medicinal plants are grown in Romania for decades for the therapeutic proprieties, for essential oils and the antibiotic action. The aim of this research paper is to determine proximate composition (moisture, proteins, lipids, ash, carbohydrates) and the content of some elements (Mg, Ca, K, Zn and Fe) in medicinal plants species grown mainly in the western part of Romania, belonging to the Lamiaceae family. Herba from six medicinal plant species were collected during 2014 and was determined proximate composition (moisture, ash, lipids, proteins and carbohydrates) using official AOAC methods (AOAC, 1997) and elemental composition using absorbtion spectroscopy. The results revealed that the studied medicinal plants are good source of carbohydrates and nutrients, high K content followed by Ca, Mg, Fe and Zn. In view of above facts, the medicinal plants belonging to Lamiaceae family cultivated in west side of Romania show great promise as a dietary and therapeutic source involved in human health.

Key words: Lamiaceae family, proximate, elements composition

In Romania medicinal plant cultivation has its roots in ancient times. Palaeontological and archaeological data attest the use by old Geto-Dacian tribes of different plant species existing in Romania flora for the treatment wide diversified diseases. Since the second half of the nineteenth century phytotherapy recorded explosive growth thanks to joint efforts of botanists and pharmacists in order to complex knowledge of medicinal flora in Romania (Palici I.F., 1997). Currently, the increased interest of phytotherapy has led to increased consumption of medicinal plants nationwide bringing the market to the value of 5 million euro.

The quality of medicinal plants is due by the geochemical features of the soil, the capacity of plants to accumulate nutrients, environmental pollution and fertilization (Queralt I., et al., 2005).

Climate and soil conditions in the western region of the country, Banat, favored the development of a diverse wealth and impressive variability. Regarding the number and the importance of species with pharmaceutical interest, Lamiaceae family, appears as one of the most important, providing an immense field for study and research. Lamiaceae or Labiatae family is an important dicotyledonous family comprising about 6.000 species and over 210 genres. Their importance is due primarily to therapeutic essential oils, with antibiotic action and also to odor and bitter substances recommended in biliary disease (Palici I.F., 1997).

The therapeutic value of medicinal plants is based on the relationship between chemical structure of the active substances, called active ingredients and their pharmacodynamic action exercised on reactive elements of the body. The fact that most medicinal plants have complex chemical composition from 2-3 to 30-40 chemical compounds identified in some plants explains multiple pharmacodynamic properties of one and the same plant.

Proximate and mineral composition of plants provides valuable information its medicinal and nutritional quality. The determination of ash contents is important because mineral contents may be the cause of a pharmacological effect (Hameed I., Hussain F., 2015). Herb parts, whether fresh or dried, are a rich source of minerals like potassium, calcium, iron, manganese, copper, and magnesium, the major components in the cells and extracellular fluids of organism (Stef D., et al., 2010). Mg and Ca occure in higher amounts in medicinal plants of Lamiaceae family. Also, average content of Fe in them is much higher than in the other plant materials (Arceusz A., et al., 2010).

This paper's aim is to determine proximate composition (moisture, proteins, lipids, ash, carbohydrates) and the content of some elements

(Mg, Ca, K, Zn and Fe) in medicinal plants species grown mainly in the western part of Romania, belonging to the family Lamiaceae (*Salvia officinalis* L., *Melissa officinalis* L., *Thymus vulgaris* L., *Satureja montana* L., *Ocimum basilicum* L., *Rosmarinus officinalis* L.).

MATERIALS AND METHOD

Material plants prelevation

Herba from six medicinal plant species were collected during 2014 year from experimental field of Banat's University of Agricultural Sciences and Veterinary Medicine "King Mihai I of Romania" from Timisoara (21013`E longitude, 45045` N latitude). Voucher specimens were identified at Plants Cultivation Department of Agriculture Faculty, where specimens of all the plants are deposited in the herbarium.

Proximate composition

Proximate composition (moisture, ash, lipids, proteins and carbohydrates) was determined using official AOAC methods (AOAC, 1997): protein (method 954.01); fat (920.39); ash (923.03) and moisture (925.09). Carbohydrate content was calculated as difference. Each result is the mean value of three measurements.

Elements determination

The plant material was air dried at 25°C and ground using a grinder (Grindomix Retsch GM 2000) to a fine powder. Samples of 3 g of ground plants were burned 8 h at 550°C in furnace (Nabertherm B150, Lilienthal, Germany). The ash was dissolved in HCl 20% and is brought to 20 ml in a volumetric flask.

The macroelements (K, Ca, Mg) and microelements (Fe, Zn) were determined by AAS (Varian 220 FAA equipment). The standard solution for calibration curve was prepared by diluting the standards (1000 mg/L). Mix standard solutions (ICP Multielement Standard solution IV CertiPUR) were purchased from Merck. Double distilled water was used for the preparation of reagents and standards. Concentrate nitric acid (HNO3 65%), and concentrate HCl (37%), were obtained from Merck Germany. All chemicals were trace metal grade (Suprapur). Metal concentration was obtained as the arithmetic average of three readings.

Statistical analysis

Proximate and elemental analysis was carried out three times for each parameter. Average, standard deviation (sd) and correlation was performed by using Excel Program (data analysis).

RESULTS AND DISCUSSIONS

The selected medicinal plant species belonging to the Lamiaceae family cultivated in west Romania and their medicinal uses are presented in (*table 1*) ((www.csid.ro/)). The results regarding proximate composition of six medicinal are listed in (*table 2*) and the elemental composition in (*table 3*).

On average, the increasing order of these nutrients among the plant samples is Carbohydrate>Ash >Moisture >Protein> Fat. The relative standard deviations (sd) were in the range from 0.18 to 1.32, but majority of data have standard deviation below unity, confirming good reproductibility of the applied methods.

The moisture content varied among the species. The average value for moisture content in medicinal samples was 8.79%, the minimum value was recorded to *Ocimum basilicum* L. (6.48%) and the maximum value was detected in *Satureja montana* L. (10.85%). Protein content ranged between 4.81% - 8.25%, the highest protein content was recorded in *Thymus vulgaris* L.

The low concentration of lipids was determinated in *Melissa officinalis* L., while the high content was in *Salvia officinalis* L. The ash value, which reflects the minerals content of samples, varies between 7.44% in *Rosmarinus officinalis* L. and 10.69% in *Satureja montana* L. The mean value of carbohydrates content was 67.62%. The concentration of carbohydrate was highest (74.02%) in *Ocimum basilicum* L. It closely approached by *Rosmarinus officinalis* L. (70.09%).

The proximate composition of the studied plants are in agreement with previously data reported in the literature. Proximate analysis determinate by OBICHI et al. 2005, revealed that the leaves of different medicinal plants from Lamiaceae family contained carbohydrate (71.83%), protein (10.11%), ash (9.03%), fiber (5.20%) and fat (2.26%). Proximate composition of some Ocimum gratissinum from Libya contain 9.10% protein, 10.65 moisture, 11% fat, 14.3% ash and 55.2% carbohydrates (Mlitan et al., 2014). Ullah et al., 2013 reported 8.71% moisture, 9.16 % ash, 6.82% protein 6.89% fat and 61.37 % carbohydrate in different medicinal plants from Pakistan (Ullah et al., 2013). Dipak K., et al., 2011 studied the nutritional composition of leaves and stem of three Lamiaceae members and it is observed that crude proteins ranged between 8.50%-12.30 %, the fat content was found in the range 2.00% to 4.25% and carbohydrate content was found highest in leaves of *Ocimum sanctum* (77.75%).

The experimental results regarding elemental composition of medicinal plants are presented in table 3. Potassium was the most abundant macroelement presents in medicinal plants. This is followed closely by calcium and magnesium. Potassium is an essential element for

plant metabolism by participating in the synthesis of amino acids and proteins. He acts as a biocatalyst, encouraging many physiological processes. It regulates the absorption of plants nitrogen by processing their ammonia nutrition, ammonia oxidation, and in the case of nitric nutrition, reducing nitrates. Regarding K content, the level of this macroelement in medicinal plants varies between 14602 ppm in *Melissa officinalis* L. and 28978 ppm in *Ocimum basilicum* L, in accord with previous studies: 703±03 – 51880±108 ppm (Magili et al., 2014), 7016-29688 ppm (Queralt et al.,2005), 399-15451 ppm (Yagi et al, 2013) 2450-14991 ppm (Ullah et al., 2013).

Calcium favourably influence root growth, is considered by many authors the main element for root growth together with potassium, calcium assists in maintaining cellular fluid balance. He is the antagonist of Al2+ Mg2+, Zn2+, Fe2+, K+, Na+, NH+, Al3+ ions removing their deleterious action in case of excess. Calcium neutralizes organic acids and stimulates the formation of absorbent root bristles (Sumalan R., 2006). The calcium content varies within tight limits (16072-18113 ppm), maximum value being registered in the case of *Thymus vulgaris* L. and the minimum value in the case of *Rosmarinus officinalis* L. The calcium content of plants is between 0.5 and 3%, the content of 0.5% is considered critical level (Mengel, 1979).

The largest quantities of calcium are contained in the conductive tissues of petiole and stem. Macro elements levels in plants depends on the elements content in the soil. Values obtained are in agreement with literature data. Thus, the study on macro and micronutrients content of medicinal plants from Macedonia revealed that Ca contents varied from 3057.94±1.71 mg/kg to 23279.56±7.59 mg/kg (Gjorgieva D., et al., 2011) between 9279-48022 mg/kg (Queralt I., et al., 2005), 6763±417 mg/kg to 82250±993 (Magili S., et al., 2014), respectively from 12.1–34.3 mg/g (Arceusz A., et al., 2010). Smaller values were reported in Sudanese Medicinal Plants (200-8107 ppm) (Yagi et al., 2013) and in Pakistan samples (1321-9260 ppm) (Ullah et al., 2013). The difference in the elements concentration in the medicinal plants depends on preferential absorption of the plants and also the mineral composition of the soil in which the plants are grown (Magili S., et al., 2014).

Magnesium is an essential element indispensable plant chlorophyll formation, in the synthesis of carbohydrates, lipids and proteins. He is an activator of many enzymes necessary for respiration, activating enzymes that participate in the synthesis of RNA and DNA. Insufficient magnesium in nutrition is manifested by the appearance of a yellow-orange coloration or dark green chlorite spots on the leaf margins.

Magnesium content of medicinal plant samples studied are framing between 664 ppm for *Ocimum basilicum* L, and 1460 for *Satureja montana* L. Values obtained are lower compared to data reported in the literature varies between 1648.67±0.31 mg/kg and 4296.66±1.07 mg/kg (Gjorgieva, 2011), 1616-6405 mg/kg (Queralt I., et al., 2005) and 1292-454 60 ppm (Ullah et al., 2013).

Zn it is found in small quantities in the samples studied (3.33-4.89 ppm) comparative with data reported in literature (17-68 ppm) (Queralt I., et al.,2005), 18-39 ppm (Arceusz A., et al.,2010), 8.5-95.8 ppm (Ullah et al., 2013).

Regarding iron content medicinal plants studied varies between 166.5 ppm, minimum value registered in *Melissa officinalis* L. samples and 499.5 ppm maximum value obtained for *Thymus vulgaris* L. Arceusz et al., 2010 reports a Fe content between 35.2–275 mg/g, in medicinal plants belonging to different plant families, while the values reported by other authors are: 29 - 1426 ppm (Yagi et al., 2013), 63 - 853 mg/kg (Queralt I., et al., 2005), 76.2-102.8 ppm (Ullah et al., 2013), respectively between 154-521 ppm (Gjorgieva D., et al., 2011). In plants, iron affects photosynthesis, nitrogen metabolism and oxidative phosphorylation, catalyzed biosynthesis of chlorophyll and carotenoid pigments. Iron deficiency in the body cause yellowing of leaves and plant downturn. In human body, iron, being a component of hemoglobin inside the red blood cells, determines the oxygen-carrying capacity of the blood. Inter correlation among proximate and mineral composition (table 4) of medicnal plants belonging to Lamiaceae family showed a moderate positive correlation (0.57) between proteins and moisture. Strong negative and inverse correlation (-0.91) was observed between lipids and moisture, carbohydrates and ash (-0.93), moderate negative correlation between lipids and proteins (-0.69) carbohydrates and ash, carbohydrates and moisture (-0.67). Low correlation was recorded between ash and lipids, proteins and moisture. Regarding interelements correlation we ca see low and negativ correlation between pairs Ca/Mg, Ca/Fe, moderate negativ correlation Zn/Mg, Ca/K, low and positiv correlation Mg/K, Mg/Fe, moderate positiv correlation Zn/Fe, Zn/K. No strong correlation between selected elements was recorded.

Table 1.

Selected medicinal plant species and their medicinal uses (www.csid.ro/**)**

Botanical name	Common name	Local name	Collection region	Medicinal uses
Salvia officinalis L.	sage	Jaleş de grădină, salvie	Banat	Treat and cure high blood pressure, bowel and stomach infections, airway inflammation, physical and mental exhaustion, nervousness, fever, stress, skin ulceration, cough, bronchitis, abscess, cellulites.
Melissa officinalis L.	lemon balm	Roiniță	Banat	Treat stomach problems, calms nervous conditions, increases bile balances digestion and stimulates appetite.
Thymus vulgaris L.	common thyme	Cimbru, lămâioară	Banat	Curative effect in laryngitis, flu, bronchitis, respiratory infections and whooping cough, tuberculosis. Stimulates liver function, plays a role in rheumatism, arthritis, neurosis fatigue, neurasthenia, fatigue, mental depression, headaches, listlessness, convalescence, anemia, weakness, epilepsy, paralysis; stimulates memory.
Rosmarinus officinalis L.	rosemary	Rozmarin	Banat	Stimulated action on the nervous system. It is used to treat ORL infections, particularly for treating bronchitis and relieve cough. The resulting external path is used to reduce rheumatic pain or for treating peripheral blood circulation problems.
Satureja montana L.	wild-growing savory	Cimbru de munte	Banat	In addition to being widely used as a condiment, savory has antispasmodic, antidiarrheal, antioxidant, anti-inflammatory, and chemotherapeutic properties.
Ocimum basilicum L.	basil	Busuioc	Banat	Antioxidant, antiviral, and antimicrobial, antitumoral properties. It is traditionally used for supplementary treatment of stress, asthma and diabetes mellitus.

Table 2.

Proximate composition of medicinal plants

Sample	Moisture (%)	Proteins (%)	Lipids (%)	Ash (%)	Carbohydrates (%)
Salvia officinalis L.	6,77±0.51	6.77±1.02	8.96±0.65	9.60±0.5	67.89
Melissa officinalis L.	9.64±0.98	7.54±0.18	5.85±0.12	8.44±0.24	68.18
Thymus vulgaris L.	8.71±0.43	8.25±1.06	6.95±0.25	8.66±0.49	67.43
Rosmarinus officinalis L.	7.99±0.30	6.27±1.32	8.18±0.91	7.44±0.59	70.09
Satureja montana L	10.85±0.91	7.66±0.44	6.26±0.55	10.69±0.50	64.54
Ocimum basilicum L.	6.48±0.33	4.81±0.59	5.64±0.39	9.05±0.43	74.02
Mean	**8.79**	**7.29**	**7.24**	**8.97**	**67.62**

Table 3.

Macro and microelements composition of medicinal plants

Sample	Ca	K	Mg	Fe	Zn
	ppm	ppm	ppm	ppm	ppm
Salvia officinalis L.	18080±0.50	18396±0.59	993±1.20	172.1±0.30	3,33±1.34
Melissa officinalis L.	17522±0.65	14602±1.20	793±0.91	166.5±0.56	4,21±0.67
Thymus vulgaris L.	18113±0.87	20451±0.91	1067±0.85	499.5±0.21	4,89±1.32
Rosmarinus officinalis L.	16072±0.22	24489±0.55	1009±0.20	326.3±0.91	3,87±0.67
Satureja montana L	16821±1.20	24514±0.49	1460±±0.55	368.2±1.20	3,66±0.90
Ocimum basilicum L.	17448±0.55	28978±0.33	664±0.78	479.52±0.33	5,12±0.78
Mean	**17342.67**	**20490.4**	**997.66**	**335.35**	**4.18**

Table 4.

Correlation between proximate composition and elements in medicinal plants

	Moisture	Proteins	Lipids	Ash
Proteins	0.57			
Lipids	-0.91	-0.69		
Ash	0.39	0.37	-0.19	
Carbohydrates	-0.67	-0.61	0.49	-0.93
	K	Mg	Ca	Fe
Mg	0.04			
Ca	-0.44	-0.26		
Fe	0.71	0.07	-0.02	
Zn	0.34	-0.53	0.25	0.73

CONCLUSIONS

The proximate composition revealed that the studied medicinal plants are good source of carbohydrates and nutrients, high K content followed by Ca, Mg, Fe and Zn. In view of above facts, the medicinal plants belonging to *Lamiaceae* family cultivated in west side of Romania show great promise as a dietary and therapeutic source involved in human health. These data are important for nutritional and pharmacological assessment, medicinal plant labeling and consumer education.

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