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# REGIONAL PATTERN AND CHARACTERISTICS OF ESSENTIAL ELEMENTS IN SEVERAL MEDICINAL PLANTS USING SPECTROMETRIC METHODS COMBINED WITH MULTIVARIATE STATISTICAL APPROACHES

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**ABSTRACT.** The aim of this study was to provide a regional pattern and characteristics of essential elements in several medicinal plants from North Macedonia and Romania. The content of Ca, Mg, Al, Fe, Cu, Ba and Zn was determined by ICP-OES while Na and K by FAES in some medicinal plants belonging to sixteen families. Similar profiles of elements with a high content of Ca, Mg and K were observed. Peppermint and blackberry from both countries showed extreme content in Al and Fe. A symmetric distribution for K, Ca and Zn and an asymmetric one for Na, Al, Fe and Ba were found in medicinal plants from both countries. Potassium, Ca, Mg, Al and Fe could be considered as markers for growing area. Principal Component Analysis highlighted that the variability of elements content was described by four factors (83.4%) in North Macedonia and three factors (70.0%) in Romania. The first factor could explain the influence of soil nature upon variability of elemental composition, calcareous in North Macedonia (Mg and Ca – 29.4% variance) and a rich one in hydroxides in Romania (Al and Fe – 33.1% variance).

***Keywords:*** *essential element, medicinal plant, inductively coupled plasma optical emission spectrometry, flame atomic emission spectrometry, Principal Component Analysis, two-way joining Cluster Analysis*

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## INTRODUCTION

The medicinal plants consumed preferable as teas or tinctures, have a long and rich history regarding their usage as therapeutics. The World Health Organization (WHO) estimated that 80% of the current population use medicinal plants for some aspect of primary healthcare [1]. It is thought that some medicinal plants contain elements of vital importance for human metabolism, disease prevention and healing [2]. Besides their use for treatment of diseases, the medicinal plants are also used as dietary supplements once they are found to be rich in one or more elements. So, their chemical composition in terms of nutrients, minerals, vitamins, and essential antioxidants need to be permanently monitored. Elemental content can vary in a wide range, depending on factors such as soil geochemical characteristics, the climate conditions, irrigation water, use of fertilizers and the ability of each plant species to selectively accumulate some of them [3, 4]. Metals, categorized as macro (primary) or micro (trace) elements play an essential role in the body some of them being crucial for many body functions. Essential elements such as sodium, potassium, calcium, magnesium, phosphorus, iron, zinc, copper, manganese and non-essential elements such as aluminium, barium, cadmium and lead were found in various medicinal plants [5]. Macroelements such as potassium, calcium, magnesium, phosphorus, and sodium are contained in concentration greater than 100 mg $kg^{-1}$ while trace elements including iron, zinc, manganese, molybdenum, selenium, chromium, copper, cobalt and sulphur are usually contained in concentration less than 100 mg $kg^{-1}$ [6].

The determination of elements in medicinal plants and their impact on human health is of great importance. Besides, their essential importance in the living system, several elements can be toxic when the concentrations exceed those necessary for metabolic functions [7, 8]. The level of elements permitted by the WHO should not endanger the health of consumers [9, 10]. Inductively coupled plasma-optical emission spectrometry (ICP-OES), atomic absorption spectrometry (AAS) and neutron activation analysis (NAA) methods have been used for the determination of elements concentration in medicinal plants and plant based multivitamin preparations [11, 12].

The aim of this paper was to provide a regional pattern and characteristics of essential elements in several medicinal plants from Romania and North Macedonia using spectrometric methods combined with multivariate statistical approaches. Romania and North Macedonia possesses a great vegetal genetic diversity, as for example Romania cover 30% of the European flora with a number of 3700 plant taxa, from which 283 were identified as medicinal plants [13, 14]. However, according to our best knowledge there are