# CROP PRODUCTION

**DOI: https:/doi.org/10.23649/jae.2020.3.15.4**

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Received: 15.07.2020; Accepted: 25.07.2020; Published: 11.09.2020

# THE ELEMENTAL COMPOSITION OF *MENTHA PIPERITA L.* (*LAMIACEAE LINDL.*), GROWN IN THE FOREST-STEPPE ZONE OF SOUTHERN URALS

Research article

**Abstract**

The article analyzes the raw materials of the terrestrial part of a perennial spicy-aromatic plant of the family (*Lamiaceae* Lindl.) *Mentha piperita* L.*,* introduced into the forest-steppe zone of the South Urals, for the content of 37 chemical elements. The studied species proved to be a concentrator of chemical elements. *Mentha piperita* L.*,* is an accumulator: in the terrestrial part of this plant, the concentration of three elements (zinc, molybdenum, silver) was higher than in the soil. The content of most of the studied elements in the terrestrial part of the plant does not go beyond the limits of fluctuations of chemical elements in plants growing in the Republic of Bashkortostan. Our data on the content of chemical elements in the object of study allow us to offer peppermint to reduce or eliminate the imbalance of zinc and molybdenum elements in the body.

**Keywords:** *Mentha piperita* L., chemical elements, elemental composition, spicy aromatic plants, macro- and microelements, accumulation coefficient, element content

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Получена: 15.07.2020; Доработана: 25.07.2020; Опубликована: 11.09.2020

# ЭЛЕМЕНТНЫЙ СОСТАВ МЯТЫ ПЕРЕЧНОЙ – MENTHA PIPERITA L. (LAMIACEAE LINDL.), ВЫРАЩИВАЕМОЙ В ЛЕСОСТЕПНОЙ ЗОНЕ ЮЖНОГО ПРЕДУРАЛЬЯ

Научная статья

**Аннотация**

В статье дан анализ сырья наземной части многолетнего пряно-ароматического растения семейства Губоцветные (*Lamiaceae* Lindl.) *Mentha piperita* L., интродуцированная в лесостепную зону Южного Предуралья, на содержание 37 химических элементов. Изученный вид проявил себя как концентратор химических элементов. Мята перечная является накопителем: в наземной части этого растения концентрация трех элементов (цинка, молибдена, серебра) оказалась выше, чем в почве. Содержание большинства изученных элементов в наземной части растения не выходит за пределы колебаний химических элементов в растениях, произрастающих в Республике Башкортостан. Полученные нами данные о содержании химических элементов в объекте исследования позволяют предложить мяту перечную для уменьшения или устранения дисбаланса элементов цинка и молибдена в организме.

**Ключевые слова:** *Mentha piperita* L., химические элементы, элементный состав, пряно-ароматические растения, макро- и микроэлементы, коэффициент накопления, содержание элементов

## 1. Introduction

Spice-aromatic and essential oil plants are widely used in various industries: food, pharmaceutical, perfume, cosmetics, tobacco, canning, etc. Many of them have long been used in folk and official medicine, due to the content of a variety of biologically active substances, as well as macro- and microelements.

Analysis of blood and hair for the content of chemical elements in residents of some districts of Bashkortostan showed the presence of an imbalance of chemical elements [1, P.47]. One of the ways to correct the imbalance of elements in the human body is the use of plants containing a complex of mineral substances. Therefore, the study of their chemical composition is an important and integral part of scientific research.

Previously, we published data on the content of chemical elements in the ground part of five species of annual plants in this group [2, P.33]. This article presents the results of a similar study of perennial spicy-aromatic plants. The purpose of this work is to determine the elemental composition of plant raw materials of perennial spicy-aromatic plants. The purpose of the study was to determine the content of 37 chemical elements and their isotopes in the soil and in the ground mass of the object of study, to calculate the accumulation coefficients of individual elements.

**2. Methods**

The object of study was *Mentha piperita* L.-peppermint of the family *Lamiaceae* Lindl. Raw materials were obtained as a result of the introduction of these species in the forest-steppe zone of Northern Bashkortostan on the basis of the agrobiostation of the Birsk branch of the state budgetary educational institution of higher education «Bashkir State University».

Analysis of plant raw materials and soil to determine the elemental composition was carried out. by inductively coupled plasma mass spectrometry ICP-MS. PLASMA-QUAD, VG instruments. Soil samples were taken from the $A_P$; $A_2B$; $B_1$; $B_2$; C horizons at the location of the collection of spicy-aromatic plants at the agrobiostation of the Birsk branch of the state budgetary educational institution of higher education «Bashkir State University», where experimental studies on the introduction of these species were conducted; each sample was analyzed separately. The soil of experimental plots of a grey forest heavy loam. According to F. Khaziev (1995), the pH of such soils is 5,7. The content of humus at a depth of 0-30 cm – 4.5%, mobile phosphorus ($P_2O_5$) – 2.02 mg/100 g, mobile potassium ($K_2O_5$) – 9.8 mg/100 g, the content of total nitrogen on average is 0.26% [3, P.193]. Samples for analysis were prepared according to standard methods used in soil science [4, P.28]. The content of chemical elements in plant samples per dry mass was compared with the average content of these elements in the soil to determine the accumulation coefficient (KN) of the element, which was calculated as the ratio of the element content in dry biomass (mg/kg) to its content in the soil (mg/kg). Accumulators of chemical elements were considered species that had a KN value of about one and higher [5, P.92].

We have considered the elements studied by us based on the classification, according to which all mineral elements found in the body are divided into three groups – vital (essential), probably (conditionally) necessary, and elements whose role is little studied or unknown [6, P.71].

**3. Results**

Data on the content of five vital and three conditionally necessary chemical elements in the soil and in the studied species are presented in table 1.

Table 1 - The content of essential elements in the soil and ground part of *Mentha piperita L.*, (mg / kg)

| № | Element | Soil | Limits of fluctuations in the concentration of elements in plants RB * | Mentha piperita |
|---|---|---|---|---|
| 1 | Zn | 48,0 | 0,0-185 | **53,0** |
| 2 | Mn | 1138 | 29-289 | 211 |
| 3 | Mo | 0,5 | 0,04-2,2 | **0,69** |
| 4 | Se | 0,35 | 0,13-5,9 | 0,00 |
| 5 | I | 6,9 | - | 0,00 |
| 6 | $Fe_{54}$ | 80760 | - | 676 |
| 7 | $Fe_{57}$ | - | 981-7710 | 2930 |
| 8 | Co | 21,8 | 0,05-2,2 | 0,69 |
| 9 | Cu | 60,0 | 1,3-67,0 | 22,0 |
| LSD 05 | | 0,31 | | |

*Note: * literature data (according To Shakirov Yu. S. [7, P.102]); dash - the content of the element was not determined*

Analyzing the data in table 1, it can be noted that the content of chemical elements of this group in plant raw materials is extremely uneven – from complete absence to a significant excess in comparison with the content of the element in the soil. So, selenium and iodine are completely absent in the ground part, while it is determined in the soil. The content of zinc and molybdenum is higher than in the soil. This view is a storage of element data. The content of all other essential elements in the plant material was less than in the soil. The content of all the studied elements of this group falls within the limits of fluctuations of chemical elements in plants growing in the Republic of Bashkortostan. Data on the content of 24 more elements and 4 isotopes, the role of which for humans is little studied or unknown, are presented in table 2.

Table 2 - Content of elements whose role is poorly understood or unknown in soil and ground *Mentha piperita L.* (mg / kg)

| № | Element | Soil | Limits of fluctuations in the concentration of elements in plants RB * | Mentha piperita |
|---|---|---|---|---|
| 1 | Ti | 10438 | 16-544 | 102,0 |
| 2 | V | 156,2 | 1,40-53,0 | 29,00 |
| 3 | $Cr_{52}$ | 237,4 | 1,10-34,0 | 26,00 |
| 4 | $Cr_{53}$ | - | - | 56,00 |
| 5 | Ni | 92,6 | 1,40-106,0 | 20,00 |
| 6 | As | 5,72 | 0,26-7,20 | 0,77 |
| 7 | Sr | 128,2 | 5,10-419,0 | 65,00 |
| 8 | Cd | 0,4 | 0,04-2,30 | 0,11 |
| 9 | Li | - | 0,10-46,0 | 1,40 |
| 10 | Be | 2,44 | 0,10-0,61 | 0,05 |
| 11 | Sc | 24,8 | 0,10-4,10 | 0,21 |
| 12 | $Ga_{69}$ | - | - | 4,00 |
| 13 | $Ga_{71}$ | 12,6 | 0,01-1,70 | 0,28 |
| 14 | Ge | 1,64 | 0,01-2,50 | 0,00 |
| 15 | Rb | 34,0 | 3,10-31,0 | 2,40 |
| 16 | $Zr_{90}$ | - | 0,00-157,0 | 0,86 |
| 17 | $Zr_{91}$ | 270,6 | - | 1,10 |
| 18 | Ag | 0,07 | 0,10-2,20 | **1,60** |
| 19 | Sn | - | 7,70-86,0 | 0,49 |
| 20 | Sb | 0,4 | 0,00-0,90 | 0,00 |
| 21 | Cs | 2,6 | 0,00-0,54 | 0,01 |
| 22 | $Ba_{135}$ | - | - | 70,00 |
| 23 | $Ba_{137}$ | 134,2 | 7,30-114,0 | 69,00 |
| 24 | Hg | 0,0 | 0,00-0,70 | 0,00 |
| 25 | Pb | 19,6 | 0,00-0,79 | 0,00 |
| 26 | Bi | 0,45 | 0,00-0,37 | 0,08 |
| 27 | Th | 8,88 | 0,00-1,70 | 3,00 |
| 28 | U | 2,5 | 0,00-1,10 | 0,01 |
| LSD 05 | 0,2 | | | |

*Note: * literature data (according To Shakirov Yu. S. [8, P.119]); dash - the content of the element was not determined*

Analysis of the data in table 2 allowed us to note that the presence of all detectable elements was found in the soil except for mercury, which was not detected in the raw material. The studied plant also lacked antimony, germanium and lead ions, which were detected in the soil. According to our data, peppermint is a silver accumulator (KN=22.86).

Thus, it can be noted *Mentha piperita* L. is the leader-accumulator of Ag, Mo, Zn.

The content of most elements of this group does not go beyond the fluctuations of chemical elements in plants growing in the Republic of Bashkortostan. However, we can note a higher concentration of thorium ions in the ground part and peppermint. It is also worth noting that the concentration of tin in the studied form is significantly lower than the limits of fluctuations of this element in other plants of Bashkortostan.

The study allows us to formulate the following main conclusions:

The elemental composition of *Mentha piperita* L. is quite rich: 35 of the 37 identified elements were found in the raw material, and antimony, germanium, lead and mercury are absent.

The studied species showed itself as a concentrator of chemical elements. *Mentha piperita* L. is an accumulator: in the ground part of this plant, the concentration of three elements (zinc, molybdenum, silver) was higher than in the soil. There was a significant increase in zinc in the plant - by 5 mg / kg, molybdenum-by 0.19 mg / kg, silver-by 1.53 mg/kg (the content of most of the studied elements in the ground part of the plant does not go beyond the fluctuations of chemical elements in plants growing in the Republic of Bashkortostan). A particularly significant increase is observed for silver (KN=22.86), so you can consider *Mentha piperita* L. as a silver accumulator. The content of most of the studied elements in the ground part of the plant does not go beyond the fluctuations of chemical elements in plants growing in the Republic of Bashkortostan. Our data on the content of chemical elements in the object of research allow us to suggest peppermint to reduce or eliminate the imbalance of zinc and molybdenum elements in the body.

## Conflict of Interest

None declared.

## Конфликт интересов

Не указан.

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