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CONTENT OF MICROELEMENTS IN RAW MATERIALS OF BASIL (*OCIMUM BASILICUM* L.), SAVORY (*SATUREJA HORTENSIS* L.) AND MARJORAM (*ORIGANUM MAJORANA* L.) COLLECTED IN THE DIFFERENT STAGES OF PLANT DEVELOPMENT

Summary. In the herb of sweet basil (*Ocimum basilicum* L.) cv. 'Wala', summer savory (*Satureja hortensis* L.) cv. 'Saturn' and marjoram (*Origanum majorana* L.) cv. 'Miraż' content of microelements was determined in the successive developmental stages of the plants. The microelements content in the studied herbs was represented in the following order: iron > zinc > manganese > copper. In the vegetation period, marjoram accumulated the greatest amount of iron and manganese, while basil showed the greatest amount of zinc and copper. The variable content of microelements in the raw material depended on the species and the developmental stage of plant.

Key words: microelements, basil, savory, marjoram, plant development stage

Introduction

Mineral components represent a group of compounds which are indispensable in human nutrition. Since the human organism is not able to produce them, they should be supplied together with nutrition in adequate amounts. Raw materials of herbs contain significant amounts of mineral substances and they are a valuable source of easily accepted components in the diet (KOŁODZIEJ 1992).

Microelements, in spite of the fact that they occur in negligible amounts, have rather functional activity than a structural one. They take part in life processes as biocatalysers (GRIFFITH 1994, BRZOZOWSKA 1998, 1999).

Iron guarantees the activity of many enzymatic systems of human body. It occurs as a factor binding oxygen in hemoglobin and myoglobin. It displays also redox properties (KOŁODZIEJ 1992, BRZOZOWSKA 1999).

Zinc takes part in the transformations of proteins, nucleic acids and fats as well as in the metabolism and assimilation of iron compounds. It affects the development of the central nervous system increasing among others the ability of learning and it is indispensable in ossification processes and accelerates the healing of wounds. It has also a beneficial effect on arteriosclerosis and regulates the development of sexual glands (GRIFFITH 1994, KOŁODZIEJ 1992, BRZOZOWSKA 1998).

Manganese takes part in many biochemical reactions and in the transformations of vitamin C. It activates some oxidizing enzymes. Deficit of manganese may cause disturbances in the development of bones and sexual organs (BRZOZOWSKA 1999).

Copper is a component of many enzymes, it plays an important role in the creation of erythrocytes and it has an effect on immune system. Proper level of copper in the organism increases the assimilation of iron. A long lasting deficiency of copper causes anaemia and growth disturbances (GRIFFITH 1994, KOŁODZIEJ 1992, BRZOZOWSKA 1998, 1999).

Daily microelements requirements for adults per person are the following: 15-18 mg Fe, 15-20 mg Zn, 2-4 mg Cu, 3 mg Mn (KOŁODZIEJ 1992, ZIEMLAŃSKI et AL. 1998).

The objective of this work was the determination of changes in the content of iron, zinc, manganese and copper in the herb of selected plants in the developmental stages and the indication of an optimal term of harvest in reference to content of the examined microelements.

Material and methods

In the years 2005 and 2006, in the Research Institute of Medicinal Plants in Plewiska near Poznań, a field experiment was carried out on grey-brown podzolic soil. The objects of the studies were herbs belonging to Lamiaceae family: sweet basil (*Ocimum basilicum* L.) cv. 'Wala', summer savory (*Satureja hortensis* L.) cv. 'Saturn' and marjoram (*Origanum majorana* L.) cv. 'Miraż'.

Content of microelements was determined in the raw material of herbs which was sampled in four developmental phases of plants: A – vegetative stage, B – beginning of flowering, C – full flowering, D – seed setting.

Herb material was collected manually, then it was dried at 35°C and ground. The raw material was subject to "wet" mineralization in a mixture of H_2SO_4, HNO_3 and $HClO_4$ in the proportion 10:1:1 (METODY... 1972). Microelements Fe, Zn, Mn and Cu were determined by atomic absorption method (AAS) (NOWOSIELSKI 1988).

Results and discussion

Among the determined microelements, the content of iron in selected herbs was the highest (mean value: 455.60 mg/kg). Zinc was accumulated by the plants in a nine times

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smaller amount (mean: 51.37 mg/kg) than iron, manganese – in a 12 times smaller amount (mean: 37.97 mg/kg) and copper – in about 33 times smaller amount (mean: 13.94 mg/kg) (Table 1).

Table 1. Mean contents of microelements in the raw material of herbs plants (mg/kg)
Tabela 1. Średnie zawartości mikroelementów w wybranych surowcach zielarskich (mg/kg)

Nutrient	Sweet basil	Summer savory	Marjoram
Fe	341.23	412.68	612.90
Zn	68.82	44.00	41.28
Mn	37.17	30.21	46.53
Cu	16.15	13.30	12.38

Content of iron in the raw material of the studied species varied from 247.4 mg/kg (basil – vegetative stage) to 672.20 mg/kg (marjoram – beginning of flowering). During vegetation, the greatest amount of iron was accumulated by marjoram, in an intermediate place was savory and in the third position was basil. Significant contents of iron in marjoram were confirmed by studies of other authors (MARSH et AL. 1977, KOŁODZIEJ 1992, KLUSZCZYŃSKA 2001). Considering iron content, the best phase of marjoram and basil harvest was the beginning of flowering and for savory – the full flowering (Fig. 1).

Content of zinc in the raw material was within 33.35 mg/kg (savory – vegetative stage, marjoram – full flowering) to 71.0 mg/kg (basil – beginning and full flowering). In contrast to iron, the greatest amount of zinc was accumulated by basil followed by savory and marjoram. From the point of view of the maximal accumulation of zinc in the raw material, the most favourable phases for harvest were: for basil the phases of flowering, and for savory – the phase of full flowering and seed setting. On the other hand, during the whole vegetation period, the amount of zinc in the raw material of marjoram was similar with a tendency to a slight increase of zinc and also manganese in the phases of the beginning of flowering and in seed setting.

The greatest amount of manganese during vegetation was accumulated by marjoram, then by basil followed by savory. The content of manganese ranged from 17.65 mg/kg (savory – beginning of flowering) to 53.65 mg/kg (marjoram – seed setting). In basil, manganese content increased until the phase of full flowering. In savory, the greatest amount of manganese was determined in the phase of seed setting and the smallest amount was found in the beginning of flowering phase (Fig. 2).

Analysis of copper content, independent of the species, showed the greatest amount in the phase of seed setting. The copper content ranged from 10.9 mg/kg (marjoram – vegetative stage) to 22.2 mg/kg (basil – seed setting). The greatest amount of copper, similarly as in case of zinc, was accumulated during vegetation by basil, then by savory followed by marjoram.

Our studies have confirmed the findings of other authors (KOŁODZIEJ 1992, WITOSZYŃSKA and JENDRYCZKO 1994), that herbal plants are a useful source of microelements.

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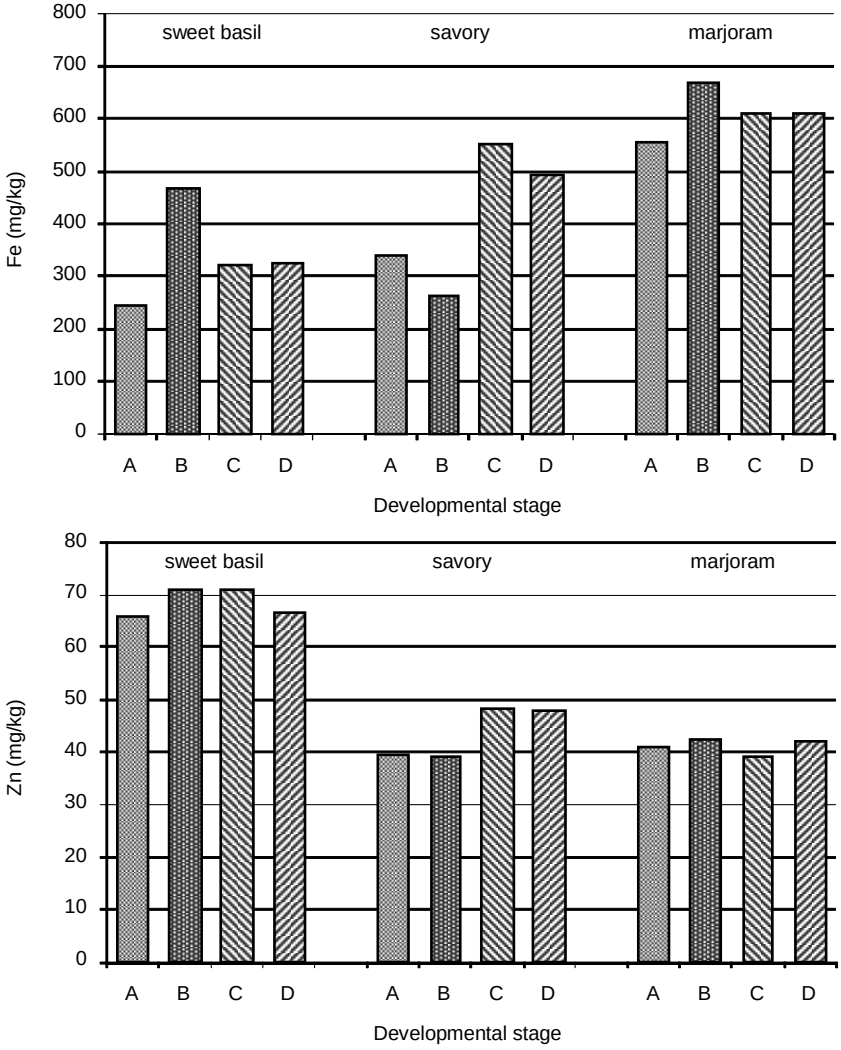

Fig. 1. Iron and zinc content in the raw material of the selected herbal plants depending on developmental stage of plants: A – vegetative stage, B – beginning of flowering, C – full flowering, D – seed setting

Rys. 1. Zawartość żelaza i cynku w wybranych surowcach roślin zielarskich w zależności od fazy rozwojowej roślin: A – wzrost wegetatywny, B – początek kwitnienia, C – pełnia kwitnienia, D – wykształcenie nasion

In the present work, attention was focused on the high variability in the content of microelements in selected herbal plants depending on the developmental stage and on the species. This fact is a confirmation of results obtained in the experiments of KOŁODZIEJ (1996) and SUCHORSKA-ORŁOWSKA et AL. (2006).

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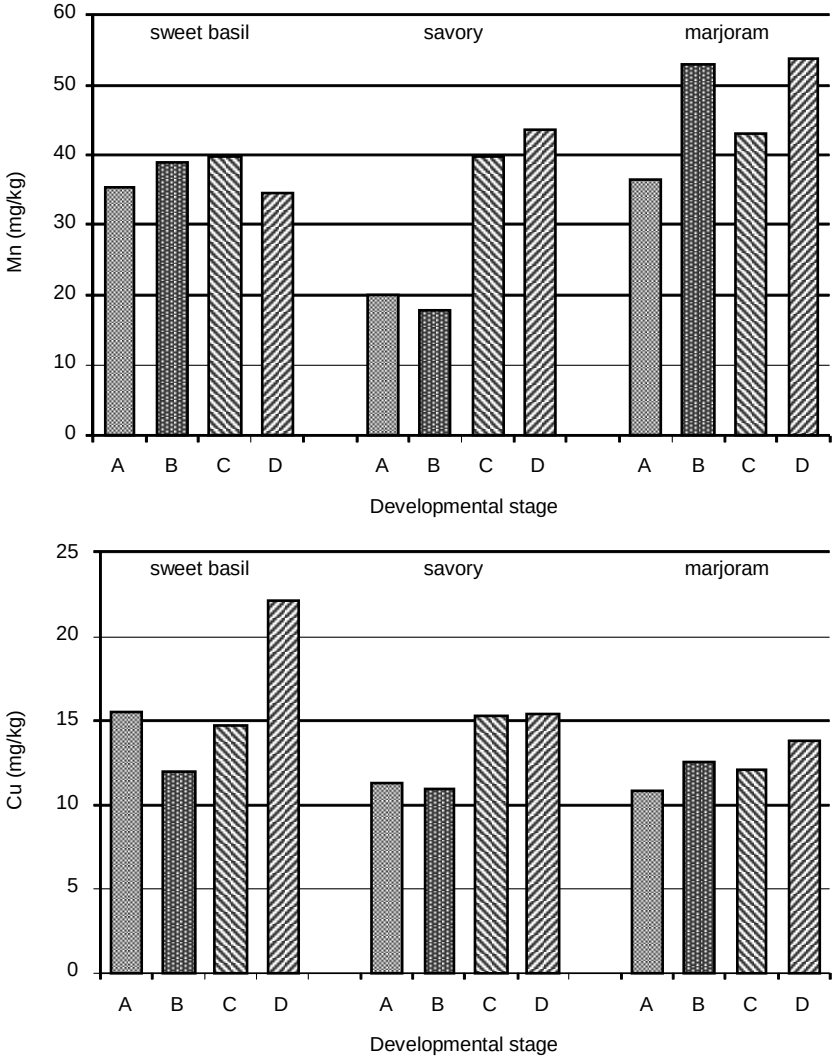

Fig. 2. Manganese and copper content in the raw material of the selected herbal plants depending on developmental stage of plants: A – vegetative stage, B – beginning of flowering, C – full flowering, D – seed setting

Rys. 2. Zawartość manganu i miedzi w wybranych surowcach roślin zielarskich w zależności od fazy rozwojowej roślin: A – wzrost wegetatywny, B – początek kwitnienia, C – pełnia kwitnienia, D – wykształcenie nasion

Conclusions

1. Content of microelements in the raw materials of the tested herbs depended on the species and developmental phase of plant.

2. The greatest amount of iron was determined in the herbs of marjoram and basil harvested at the beginning of flowering, and in the herb of savory in the full flowering phase.

3. The maximal amounts of zinc and manganese were accumulated by marjoram in the phases of the beginning of flowering and in seed setting; in basil, the greatest amounts of both elements were found in the phase of flowering, while in savory, it was in full flowering and in seed setting.

4. The studied herbs accumulated the greatest amounts of copper in the phase of seed setting.

5. In the whole period of vegetation, marjoram accumulated the greatest amounts of iron and manganese, while basil showed the greatest accumulation of zinc and copper.

6. The content of microelements in the herb of the studied plants can be arranged in the following way: iron > zinc > manganese > copper.

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ZAWARTOŚĆ MIKROSKŁADNIKÓW W SUROWCACH BAZYLII POSPOLITEJ (*OCIMUM BASILICUM* L.), CZĄBRU OGRODOWEGO (*SATUREJA HORTENSIS* L.) I MAJERANKU ZWYCZAJNEGO (*ORIGANUM MAJORANA* L.) ZEBRANYCH W KOLEJNYCH FAZACH ROZWOJOWYCH ROŚLIN

Streszczenie. W zielu bazylii pospolitej (*Ocimum basilicum* L.) odm. ‘Wala’, cząbru ogrodowego (*Satureja hortensis* L.) odm. ‘Saturn’ i majeranku ogrodowego (*Origanum majorana* L.) odm. ‘Miraż’ oznaczono zawartości mikroskładników w kolejnych fazach rozwojowych roślin. Zawartość mikroskładników w zielu badanych roślin przyprawowych przedstawiała się następująco: żelazo > cynk > mangan > miedź. W okresie wegetacji majeranek gromadził najwięcej żelaza i manganu, natomiast bazylia – najwięcej cynku i miedzi. Zmienna zawartość mikroskładników w surowcu wynikała z fazy rozwojowej roślin i gatunku.

Słowa kluczowe: mikroelementy, bazylia, cząber, majeranek, faza rozwojowa

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