Estimation of biological value of some species of mint (*Mentha* L.)

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Summary

In 2006–2007 the studies aimed to compare the biological value of fresh herb of wrinkled-leaf mint (*Mentha crispa* L.), water mint (*Mentha aquatica* L.) and three varieties of peppermint: bergamot mint (*Mentha x piperita* L. var. *citrata* Ehrh.), white peppermint (*Mentha x piperita* L. var. *officinalis* Sole f. *pallescens* Camus) and black peppermint (*Mentha x piperita* L. var. *officinalis* Sole f. *rubescens* Camus) were carried out. Content of dry matter, chlorophyll a, total carotenoids, total polyphenols and antioxidant activity (herb and oil) differed significantly in the species and varieties of mint tested in the experiment. Significantly higher content of dry matter was noted for bergamot mint (24.24%), chlorophyll a – for black peppermint (1574.83 mg·kg^{-1} f.m.), total carotenoids – for wrinkled-leaf mint (431.98 mg·kg^{-1} f.m.), total polyphenols – for water mint (450.25 mg·100g^{-1} f.m.) and antioxidant activity – for black peppermint, water mint and wrinkled-leaf mint (on average 84.43%). Among species tested in the experiment the highest antioxidant activity of the essential oil was assessed for wrinkled-leaf mint (29.78%).

Key words: *Mentha crispa, Mentha aquatica, Mentha x piperita, biological value, antioxidant activity*

INTRODUCTION

The Lamiaceae family includes about 220 genera and 3300 species which are widely used worldwide for various purposes [1]. The genus *Mentha* is one of the important members of the family. Mint herb is used in medicine, cosmetics and food industry, therefore, this species is widely grown around the world. Black peppermint produces a large amount of essential oils and has a better aroma than the white one. Thus, it is more widely grown, especially for industrial processing [2, 3].

Plants belonging to the Lamiaceae family are rich in polyphenolic compounds and a large number of them, such as sage, oregano, thyme, basil and mint, show strong antioxidant activity [4-8]. The antioxidative effect is mainly due to phenolic components, such as flavonoids [9, 10], phenolic acids, and phenolic diterpenes [11, 12]. Apart from polyphenols, among the important constituents participating in the cell defence system against free radicals are: vitamin C, vitamin E and carotenoids [13-16]. According to Oszmiański and Lamer-Zarawska [17], a protective activity in many cancer diseases have also a dietary fibre, folic acid and chlorophylline.

The aim of this work was to compare the content of biologically active compounds in the fresh herb of some mint species. Moreover, antioxidant activity of the mint essential oils was determined.

MATERIAL AND METHODS

The experiment was conducted in 2006–2007 in the Laboratory of Processing and Storage of Plant Raw Material of Agricultural University in Szczecin.

The research material was reproduced at the Horticultural Experiment Station in Dołuje which belongs to the Department of Vegetable Growing of Agricultural University in Szczecin. The experimental material consisted of fresh herb of:

Mentha crispa L. – wrinkled-leaf mint,

Mentha aquatica L. – water mint,

Mentha x piperita L. var. *citrata* Ehrh. – bergamot mint,

Mentha x piperita L. var. *officinalis* Sole f. *pallescens* Camus – white peppermint (French peppermint),

Mentha x piperita L. var. *officinalis* Sole f. *rubescens* Camus – black peppermint (English peppermint).

The experiment was carried out using the split-block method in three replications. The plot area was 5 m^2. The field was prepared according to agrotechnology proper for these species. Mineral fertilization was quantified according to the results of chemical analysis of the soil. During the growing season the crop management was carried out. It included mainly irrigation, weeding and soil cultivation [18].

The plants harvest was done just before flowering phase. The chemical analyses of plant material (fresh herb) included determination of the content of dry matter (drying at 105°C to constant weight), total chlorophyll, chlorophyll a and b [19], vitamin C as L-ascorbic acid (by the method of Tillmans), total carotenoids [19], total polyphenols – by spectrophotometer, using gallic acid as a reference, Follin-Ciocalteu reagent [20] and antioxidant activity. Scavenging effect of mint herb extract on DPPH (2,2-diphenyl-1-picrylhydrazyl) radical was determined according to the method of Yen and Chen [21]. Raw homogenised material was diluted 200 times in methanol (70%). DPPH percent inhibition was calculated according to Rossi et al. [22].

Antioxidant activity was also determined for essential oil achieved from dried herb of mint with use of distillation of the sample together with water in Deryng's apparatus [23]. The sample of obtained mint oil was diluted 100 times in 100% methanol.

The results of each year were subjected to an analysis of variance. The means of two years were separated by the Tukey's test at $p=0.05$.

RESULTS AND DISCUSSION

In the present work there were significant differences noted between mint species with regard to the content of dry matter, chlorophyll a, total carotenoids, total polyphenols and antioxidant activity.

Significantly higher content of dry matter was noted for bergamot mint (tab. 1). It has contained on average by 3.88% of dry matter more in comparison with the other species between which significant differences were not found.

Table 1.

Content of dry matter and chlorophylls in fresh herb of some *Mentha* L. species (means for 2006–2007)

plant species	dry matter (%)	chlorophyll [mg·kg^{-1} f.m.]		
		a	b	total
Mentha x piperita L. var. *citrata* Ehrh.	24.24	1228.93	325.55	1732.47
Mentha x piperita L. var. *officinalis* Sole f. *pallescens* Camus	19.82	1401.07	393.78	2008.37
Mentha x piperita L. var. *officinalis* Sole f. *rubescens* Camus	20.35	1574.83	474.27	2294.99
Mentha crispa L.	21.59	1512.19	393.69	2122.62
Mentha aquatica L.	19.67	1462.29	519.14	2264.34
mean	*21.13*	*1435.86*	*421.29*	*2084.56*
$LSD_{\alpha=0.05}$	1.897	313.553	n.s.	n.s.

In the conducted experiment a content of chlorophylls was also determined. Significant differences were noted only for chlorophyll a. Significantly higher

amount of this coloured compound was assessed for black peppermint (1574.83 mg·kg^{-1} f.m.), while significantly lower for bergamot mint (1228.93 mg·kg^{-1} f.m.). The content of chlorophyll b amounted on average 421.29 mg·kg^{-1} f.m. for the tested species and 2084.56 mg·kg^{-1} f.m. of total chlorophyll. Ratio of chlorophyll a:b for examined species was on average 3.4:1.0. Total chlorophyll amounts observed in the study were similar to those reported by Dambrauskienë et al. [3]. They determined from 1700 to 2000 mg·kg^{-1} f.m. of chlorophylls in black peppermint cultivars.

On the basis of obtained results it was proved that fresh herb of mint is characterized by a high content of biologically active compounds (tab. 2). Content of L-ascorbic acid for the tested species amounted on average 27.62 mg·100g^{-1} f.m. Dambrauskienë et al. [3] determined 25.57 mg·100g^{-1} f.m. of L-ascorbic acid in black peppermint. Capecka et al. [16] gave in their report a much higher level of L-ascorbic acid in peppermint (52.6 mg·100g^{-1} f.m.) and similar of total carotenoids (581 mg·kg^{-1} f.m.), in comparison with the results of present study. Among the examined species, wrinkled-leaf mint was characterized by significantly higher content of total carotenoids (631.98 mg·kg^{-1} f.m.). The level of carotenoids in herb of black peppermint amounted 615.75 mg·kg^{-1} f.m.

Table 2.

Content of L-ascorbic acid, total carotenoids, total polyphenols in fresh herb and antioxidant activity of fresh herb and oil of some *Mentha* L. species (means for 2006–2007)

plant species	L-ascorbic acid [mg·100g^{-1} f.m.]	total carotenoids [mg·kg^{-1} f.m.]	total polyphenols [mg·100g^{-1} f.m.]	antioxidant activity (%)	
				fresh herb*	oil**
Mentha x piperita L. var. *citrata* Ehrh.	35.04	503.73	330.72	56.47	7.04
Mentha x piperita L. var. *officinalis* Sole f. *pallescens* Camus	21.24	548.63	232.47	35.49	21.28
Mentha x piperita L. var. *officinalis* Sole f. *rubescens* Camus	27.30	615.75	405.50	90.60	5.28
Mentha crispa L.	26.70	631.98	296.89	80.95	29.78
Mentha aquatica L.	27.84	537.73	450.27	81.73	3.28
Mean	*27.62*	*567.56*	*343.17*	*69.05*	*13.33*
$LSD_{\alpha=0.05}$	n.s.	115.146	37.302	15.211	6.901

* sample was diluted 200-times in 70% methanol

** sample was diluted 100-times in 100% methanol

Analysis of the content of total polyphenols in the plant material showed that the highest amount of these compounds was found in water mint (450.25 mg·100g^{-1} f.m.), lower – in black peppermint (405.50 mg·100g^{-1} f.m.), bergamot mint (330.72 mg·100g^{-1} f.m.) and wrinkled-leaf mint (296.89 mg·100g^{-1} f.m.) and the least – in white peppermint (232.47 mg·100g^{-1} f.m.). Similar results for black peppermint reported Nickavar et al. [1]. Capecka et al. [16] assessed 1954 mg of polyphenols in 100 g of fresh herb of peppermint.

The tested mint species differed significantly, as far as the antioxidant activity was concerned. Significantly higher antioxidant activity of fresh herb was noted for black peppermint, water mint and wrinkled-leaf mint. They did not differ significantly with respect to the ability of scavenging DPPH – free radical. In comparison with these three species, bergamot mint was characterized by significantly lower antioxidant activity and the least was determined for white peppermint. Among tested in the experiment species the highest antioxidant activity of the essential oil was assessed for wrinkled-leaf mint (29.78%), while the least for bergamot mint, black peppermint and water mint – on average 5.20%.

CONCLUSIONS

1. The tested mint species were characterized by a high content of biologically active compounds: L-ascorbic acid, chlorophylls, total carotenoids, total polyphenols and by high antioxidant activity.
2. Among species tested in the experiment significantly higher content of dry matter was determined in bergamot mint, chlorophyll a – in black peppermint, total carotenoids – in wrinkled-leaf mint, total polyphenols – in water mint, and fresh herb antioxidant activity – in black peppermint, water mint and wrinkled-leaf mint.
3. Black peppermint and water mint were characterized by a higher biological value, in comparison with bergamot mint, white pepper mint and wrinkled-leaf mint.
4. Wrinkled-leaf mint oil was characterized by the highest antioxidant activity.

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OCENA WARTOŚCI BIOLOGICZNEJ WYBRANYCH GATUNKÓW MIĘTY (*MENTHA* L.)

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Streszczenie

W latach 2006–2007 przeprowadzono doświadczenie mające na celu porównanie wartości biologicznej świeżego ziela mięty kędzierzawej (*Mentha crispa* L.), mięty nadwodnej

(*Mentha aquatica* L.) oraz trzech odmian mięty pieprzowej: cytrynowej (*Mentha x piperita* L. var. *citrata* Ehrh.), białej (*Mentha x piperita* L. var. *officinalis* Sole f. *pallescens* Camus) i czarnej (*Mentha x piperita* L. var. *officinalis* Sole f. *rubescens* Camus). Oceniane w doświadczeniu gatunki i odmiany mięty różniły się istotnie zawartością suchej masy, chlorofilu a, karotenoidów ogółem, polifenoli ogółem oraz aktywnością antyoksydacyjną (ziela i olejku). Istotnie większą zawartość suchej masy notowano w zielu mięty cytrynowej (24,24%), chlorofilu a – w zielu mięty czarnej (1574,83 $mg \cdot kg^{-1}$ św.m.), karotenoidów ogółem – w zielu mięty kędzierzawej (431,98 $mg \cdot kg^{-1}$ św.m.), polifenoli – w zielu mięty nadwodnej (450,25 $mg \cdot 100g^{-1}$ św.m.) oraz aktywność antyoksydacyjną – w przypadku mięty czarnej, nadwodnej i kędzierzawej (średnio 84,43%). Istotnie największą aktywnością antyoksydacyjną olejku charakteryzowała się mięta kędzierzawa (29,78%).

Słowa kluczowe: *Mentha crispa, Mentha aquatica, Mentha x piperita, wartość biologiczna, aktywność antyoksydacyjna*