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Nutritional Parameters of Selected Culinary Herbs (Lamiaceae)

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Abstract: This study was conducted to evaluate the contents of total phenolics and flavonoids, and total antioxidant activity in 7 species and cultivars of herbs commonly used in the fresh state (basil, marjoram, summer savory, thyme). The total flavonoid content ranged from 125 to 360 mg CE.100g^{-1} of fresh herb. The highest average total flavonoid content was found in thyme (291.2 mg CE.100g^{-1}) followed by basil cv. ´Lettuce Leaf´ (251.0 mg CE.100g^{-1}). The measured total phenolic content ranged from 0.16 g GAE .100g^{-1} to 0.80 GAE .100g^{-1}. The highest average level of total phenolics was determined in marjoram (0.577 GAE .100g^{-1}) and thyme (0.530 GAE .100g^{-1}), followed by basil cvs. ´Ohře´ and ´Compakt´ (0.363 GAE and 0.250 GAE .100g^{-1}, respectively). Total antioxidant capacity was evaluated by the Analytik Jena Photochem system. The best results were obtained again with thyme (0.891 g TE.100g^{-1}) followed by basil cv. ´Lettuce Leaf´ (0.875 g TE.100g^{-1}).

Key words*:* culinary herbs, total antioxidant capacity, total flavonoid content, total phenolic content, Lamiaceae.

Introduction

Spices and freshly cut herbs are commonly used as a flavouring in cooking, but they can be also used as traditional medicines. Fresh herbs are rich sources of bioactive compounds in human nutrition. Species from Lamiaceae and Apiaceae families contain well-known essential oils that give them the typical aroma. They also contain many other antioxidant substances, such as ascorbic acid, tocopherols, carotenoids, polyphenols (flavonoids, anthocyanins, phenolcarboxylic acids and

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coumarins). In the 1970s, scientists discovered that the human body constantly creates free radicals, culminating in an ‘oxidative stress´ (Stahl-Biskup and Venskutonis 2004). It must be eliminated by antioxidants, but in case of antioxidant deficiency, the oxidative stress can develop into the pathogenesis of many human diseases (cardiovascular diseases, cancer etc.). Therefore it is necessary to obtain sufficient levels of antioxidants from food sources. The discovery of the inhibition of lipid oxidation by some phenolic compounds during the late 1940s contributed to the use of synthetic antioxidants in the food industry (Potty and Krishna Kumar 2001). Widely used are butylated hydroxitoluen (BHT) and butylated hydroxianisole (BHA). These synthetic antioxidants are highly effective, but they are instable and can act as promoters of carcinogenesis. Due to this reason, there is a growing interest in the study of natural additives as potential antioxidants. The presence of antioxidants in many spices gives food-preserving properties too. There are many factors that affect polyphenol content in plants, apart from a number of factors that affect the content in processed foods, such as storage, heating and packaging conditions, and culinary preparation (Opara and Rockway 2006).

There are many studies focusing on determination of antioxidant content in different fruit and vegetable species, but the content of these substances in herbs in the fresh state has not yet been evaluated in detail.

Materials and methods

Plants

Four Lamiaceae species: *Satureja hortensis*, *Majorana hortensis* ´Marietta´, *Thymus vulgaris* and *Ocimum basilicum* in 4 cultivars (´Ohře´, ´Compakt´, ´Purple Opaal´ and ´Lettuce Leaf´) were used in this experiment. Seeds were obtained from the Czech seed companies Seva Flora Valtice and Semo Smržice. The plants were grown in the greenhouse of Faculty of Horticulture in Lednice as pot plants. Sowing was performed on 10 February 2009. Aerial parts were harvested with the scissors on the day of analysis – 21 and 22 April 2009.

Total flavonoid content

The total flavonoid content was measured using a modified colorimetric method (You *at al*. 2007). Distilled water was added to an appropriate amount of extract (the same, as for determination of total phenolic content) in a test tube. Then, 5% $NaNO_2$ was added. After 5 minutes, 10% $AlCl_3$ was added, followed by 1 M NaOH after another 5 minutes, and by the addition of distilled water. Catechin was used as the standard. Absorbance of the solution was measured against the blank at 510 nm after 15 minutes. The flavonoid content was expressed as mg catechin equivalents (CE) per 100 g of fresh herb.

Total phenolic content

Fresh matter was extracted using 75% methanol (Shan *at al*. 2005). The mixture was filtered after 24 hours of extraction at room temperature through filter paper. The extract was stored in the refrigerator until analysis. The total phenolic content was estimated using the modified Folin-Ciocalteu photometric method (You *at al*. 2007). An appropriate amount of filtered methanol extracts

was oxidized with Folin-Ciocalteu reagents and after 5 minutes the reaction was neutralized with saturated sodium carbonate. The solution was then immediately diluted to the volume of 50 ml with distilled water. The absorbance was measured at 750 nm after 90 minutes of incubation at room temperature against the blank. Gallic acid was used as the standard. The total phenolic content is expressed as g of gallic acid equivalents (GAE) per 100 g of fresh herb.

Total antioxidant capacity

The total antioxidant capacity was measured by a Photochem method (Analytik Jena, Germany). This method (Popov and Lewin 1996) is based on a photo induced chemiluminescence-accompanied and antioxidant-inhibitable autoxidation of luminol. Luminol is a photosensitizer, generating superoxide radicals, and also achemiluminogenic probe for free radicals. The total antioxidant capacity was expressed as g of Trolox equivalents (TE) per 100 g of fresh herb.

Statistical analysis

Significance was evaluated by analysis of variance (Anova) followed by Tukey's HSD (Honestly Significant Difference) test using the PC software Statistica Cz v. 8 (Stat Soft). Probability value of p0.05 was used as the criterion for significance of differences.

Results and Discussion

Total flavonoid content

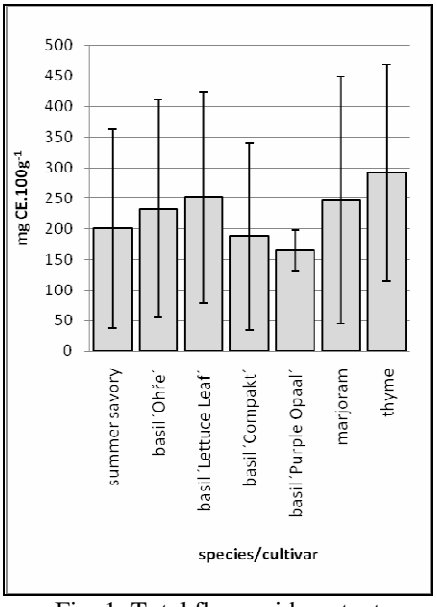

Fig. 1. Total flavonoid content

The total flavonoid content of fresh herbs was measured in methanolic extract. The results are shown in Figure 1. and Table 1. The highest level of total flavonoids was determined by *Thymus vulgaris* (291.2 mg CE.100g^{-1}). More than 200 g CE.100g^{-1} were determined by *Ocimum basilicum* ´Lettuce Leaf´ (251 mg CE. 100g^{-1}), *Ocimum basilicum* ´Ohře´ (232.9 mg CE.100g^{-1}), *Majorana hortenesis* (246.4 mg CE.100g^{-1}) and Satureja hortensis (200.0 mg CE.100g^{-1}). Ocimum basilicum ´Compact´ and ´Purple Opaal´ contained 187.4 mg CE.100g^{-1} and 164.2 mg CE.100g^{-1}. Data on total flavonoid content in fresh cut herbs were not determined. There was no significant diference in total flavonoid content among species and cultivars

Tab. 1. Content of flavonoids and polyphenols, and total antioxidant capacity

Species/cultivars	Total flavonoid content (g CE.100 g^{-1} FW)	Total phenolic content (g GAE.100g^{-1} FW)	TAC (g TE.100g^{-1} FW)
Summer savory	200.0	0.360	0.702
Basil ´Ohře´	232.9	0.363	0.817
Basil ´Lettuce Leaf´	251.0	0.347	0.875
Basil ´Compakt´	187.4	0.250	0.712
Basil ´Purple Opaal´	164.2	0.343	0.870
Marjoram	246.4	0.577	0.777
Thyme	291.2	0.530	0.891

Total phenolic content

The results on total phenolic compounds are shown in Figure 2. and Table 1.

The total phenolic content of *Thymus vulgaris* in this study (0.530 g GAE.100g^{-1}) was more than twice that measured by Zheng and Wang (2001) (0.213 g GAE.100g^{-1}). Zheng and Wang (2001) evaluated the total phenolic content in *Ocimum basilicumi* as well. They measured the level of 0.223 g GAE.100g^{-1} of fresh herb. The amount of total phenolic compounds in our study was higher in cultivars: ´Ohře´ (0.363 g GAE.100 g^{-1}), ´Lettuce Leaf´ (0.347 g GAE.100g^{-1}) and ´Purple Opaal´ (0.343 g GAE.100g^{-1}). The *Ocimum basilicum* ´Compakt´ herb containned a similar amount of total phenolic compounds (0.250 g GAE.100g^{-1}). Zheng and Wang (2001) evaluated the amount of total phenolic compounds in Satureja Montana (0.316 g GAE.100g^{-1}). The total phenolic content of Satureja hortensis in this study was 0.360 g GAE.100g^{-1}.No significant differences were observed among species and cultivars in total phenolic content.

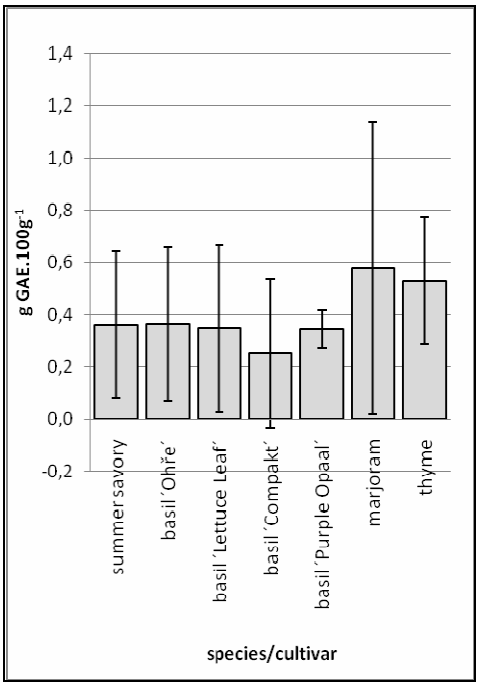

Fig. 2. Total phenolic content

Total antioxidant capacity

Figure 3 and Table 1 present results on total antioxidant capacity. TAC is dependent upon the evaluation method used. In this study, TAC was measured using Photochem equipment. It was most likely that this method was not previously used in fresh cut herbs. Therefore, there are no results to compare. TAC ranged in the 7 test species from 0.702 g of Trolox equivalents (TE).100g^{-1} (*Satureja hortensis*) to 0.891 g TE.100g^{-1} (*Thymus vulgaris*). No significant differences were observed in TAC among species and cultivars.

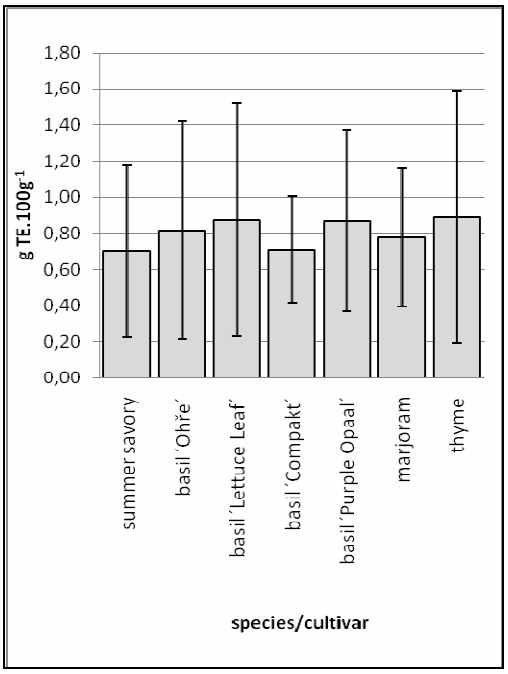

Fig. 3. Total antioxidant capacity

Conclusion

The results suggest that total phenolic and total flavonoid contents and TAC were highest in *Thymus vulgaris* and lowest in *Ocimum basilicum* ´Compact´, among the test species and cultivars.

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NUTRITIVNA VREDNOST ODABRANOG ZAČINSKOG BILJA (Lamiaceae)

- originalni naučni rad -

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Rezime

U ovom ispitivanju određivan je sadržaj ukupnih fenola i flavonoida i ukupna antioksidativna aktivnost kod 7 vrsta i sorti bilja koje se najčešće koriste u svežem stanju (bosiljka, majorana, čubra, majčine dušice). Sadržaj ukupnih flavonoida kretao se od 125 do 360 mg CE.100g^{-1} svežeg bilja. Najveći prosečni sadržaj ukupnih flavonoida utvrđen je kod majčine dušice (291,2 mg CE.100g^{-1}), a zatim kod bosiljka sorte ´Lettuce Leaf´ (251,0 mg CE.100g^{-1}). Sadržaj ukupnih fenola kretao se od 0,16 g GAE .100g^{-1} do 0,80 GAE .100g^{-1}. Najveći prosečni sadržaj ukupnih fenola ustanovljen je u majoranu (0,577 GAE .100g^{-1}) i majčinoj dušici (0,530 GAE .100g^{-1}), a kod ostalog bilja, sadržaj se kretao od 0,250 GAE .100g^{-1} (bosiljak sorte ´Compakt´) do 0,363 GAE .100g^{-1} (bosiljak sorte ´Ohře´). Ukupna antioksidativna aktivnost ispitana je pomoću Photochem uređaja nemačke kompanije Analytik Jena. Najbolje rezultate dala je majčina dušica (0,891 g TE.100g^{-1}), a zatim bosiljak sorte ´Lettuce Leaf´ (0,875 g TE.100g^{-1}).