

# ORGANICALLY CULTIVATED MEDICINAL PLANTS AND THEIR QUALITY ANALYSIS

## *Ekologické pestovanie liečivých rastlín a ich kvalitatívna analýza*

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**Summary:** Experimental works were realized in field trials at organic certified farm in western Slovakia (48°46` N; 17°38` E). Quantitative parameters of cultivated herbs were measured there: yield of air-dried part of plant as a vegetable drug and a qualitative parameter: the content of essential oil in dried drug of selected medicinal plant species: Peppermint (*Mentha x piperita* L.), Pot Marigold (*Calendula officinalis* L.), White Yarrow (*Achillea millefolium* L.), Lemon Balm (*Melissa officinalis* L.) and Sage (*Salvia officinalis* L.). Influence of growing season (2003 – 2005) on these parameters was investigated using statistical method. The quality of the air-dried drugs during the testing period met the requirements on organically cultivated medicinal plants. The drugs can be used for production of herbal teas certified by organic label as bio-products.

**Key words:** *organic farming, medicinal plants, herbs, cultivation, yields, essential oil*

**Souhrn:** Experimentálne práce boli vykonané v poľných podmienkach ekologicky certifikovaného prvovýrobcu na západnom Slovensku (48°46` SŠ; 17°38` VD). Zisťované boli nasledovné parametre pestovaných liečivých rastlín: úroda vzduchosuhej drogy (kvantitatívny parameter) a obsah silice vo vzduchosuhej droge (kvalitatívny parameter). Merania sa uskutočnili pri nasledovných druhoch liečivých rastlín: mäta pieporná (*Mentha x piperita* L.), nechtík lekársky (*Calendula officinalis* L.), rebríček obyčajný (*Achillea millefolium* L.), medovka lekárska (*Melissa officinalis* L.) a šalvia lekárska (*Salvia officinalis* L.). Bol zisťovaný vplyv pestovateľskej sezóny (2003 – 2005) na sledované parametre použitím štatistických metód. Kvalita vzduchosuhej drogy počas hodnoteného obdobia splnila požiadavky kladené na ekologickým spôsobom pestované liečivé rastliny. Dopestovaná droga bola použitá na výrobu bylenných čajov certifikovaných ako ekologické výrobky (bioprodukty).

**Klíčová slova:** *ekologické poľnohospodárstvo, liečivé rastliny, pestovanie, úrody, silica*

## Introduction

According to information edited in the 2005 organic farming is naturalized in EU-15, however the acreage is not exceed 4 % of arable land in these EU countries. Organically farmed arable land has increased about 21 % from 1998 to 2002 in EU-15. Cultivation of medicinal plants is an important part within special crops cultivated organically on arable land. The main aim of organic production of medicinal plants is to produce material with better quality as well as to sustain quality of natural resources and secure economic and social

awareness (Habán, 1998). Perspective of growing area enlargement within cultivated medicinal plants, absence of theoretical and applied research are mentioned by some authors (Černá et al., 1998; Šalamon, 2000). The objective of this study is to contribute the organic cultivation of medicinal plants by results from organically certified farm. There is described a quantity and quality of such plants harvested for tea production in this article.

## Material and methods

Organic cultivation of medicinal plants as a field experiment was established at organic certified farm in western part of Slovakia (village Rudník, Myjava district; 48°46` N, 17°38` E). Experimental plots have character of upland as a part of White Carpathian Mountains. The altitude varied from 350 to 477 m. The average year temperature of the locality is 8,2°C and precipitation reaches 670 mm. There are soil types represented by humus-carbonate and cambic soils at the locality with low content of phosphorus, middle of potassium, high of magnesium, and higher content of clay. The pH of soils ranged from acid to neutral.

These five medicinal plant species were used to analyze their quantities and qualities: Peppermint (*Mentha x piperita* L.), Pot Marigold (*Calendula*

*officinalis* L.), White Yarrow, (*Achillea millefolium* L.), Lemon Balm (*Melissa officinalis* L.) and Sage (*Salvia officinalis* L.). Brief description of cultivated varieties: Peppermint var. 'Mentola' - diploid Mitcham type characterized by dark green leaves with darker anthocyan nervation in leaves. Stem is linear; leaves are glossy with short stalks. It is resistant against lodging and freezes during winter with excellent regeneration after cutting and good stool ability. Plants dispose by favorable rate of leaves to whole biomass production (60 %); stems after harvest do not lignify. Peppermint var. 'Grüneminze' originates in Germany. It disposes of high content of essential oil and high rate of menthol in the oil. It is characterized by complete and dense stand, susceptible to winter killing, resistance against lodging

with excellent regeneration after cutting. Plants dispose by more favorable rate of leaves to whole biomass production (65 %). Pot Marigold var. 'Plamen' - traditional variety, marketable for a long time in processing technologies. Constant yields of drug are provided – rich orange flowers with stabile color. White Yarrow – biological material originates from natural harvest. It is a perennial plant grows to the 1.2 m high. Direct stem is branched on the top. The content of essential oil in the air-dried drug fluctuated from 0.2 to 0.4 % (V/m). Lemon Balm var. 'Zitronella' - German origin, average content of essential oil in the air-dried drug do not exceed 0.3 %. It obtains similar yield parameters as well known Czech variety 'Citra'. Sage var. 'Krajova' - relatively old variety, registered in 1952,

achieves stable yields with average content of the essential oil. It is resistant against lodging, pests and diseases.

Each medicinal plant species was cultivated in single blocks ranged in circle crop rotation. There were determined reference experimental areas in each block (1,0 m<sup>2</sup>), in which sampling with three replication was done. Factors of the experiment: (1) quantitative parameter: yield of air-dried drug, e.g. pharmaceutically interesting part of herbs; (2) quantitative parameter: content of an active ingredient, e.g. essential oil in these drugs. Influence of different growing seasons (2003 – 2005) on yield and its quality was evaluated. Results were evaluated using analysis of variance (ANOVA).

## Results and discussion

**Table 1: Yields of air-dried drug of medicinal plants (kg.ha<sup>-1</sup>) and content of essential oil in the drug (ml.dm<sup>-3</sup>).  
Úroda vzduchosuchoej drogy léčivých rostlín (kg.ha<sup>-1</sup>) a obsah silice v droge (ml.dm<sup>-3</sup>).**

Species	Year	2003	2004	2005	2003-2005
<i>Mentha x piperita</i> L.	Yields	2 558.3 b	3 183.3 a	2 610.0 b	2 783.9
	Ess. oil	17.0 a	13.0 b	11.0 c	13.66
<i>Calendula officinalis</i> L.	Yields	2 051.6 b	2 238.0 b	2 726.6 a	2 338.8
	Ess. oil	1.0 a	0.7 b	0.5 c	0.73
<i>Achillea millefolium</i> L.	Yields	4 736.6 a	4 116.6 b	4 316.6 b	4 390.0
	Ess. oil	3.5 b	3.7 a	3.2 c	3.40
<i>Melissa officinalis</i> L.	Yields	2 708.3	3 443.3	3 050.0	3 067.2
	Ess. oil	2.5 b	2.7 a	2.4 c	2.53
<i>Salvia officinalis</i> L.	Yields	1 335.3 b	1 910.0 a	1 368.3 b	1 537.8
	Ess. oil	17.0 a	15.0 b	15.0 b	15.60

Yields of air-dried drug of selected medicinal plants and content of essential oil in the drug during three seasons are presented in Table 1. Significantly lowest yields were reached in the first year of experiment almost within all cultivated medicinal plant species (*Mentha x piperita* L., *Calendula officinalis* L., *Melissa officinalis* L., *Salvia officinalis* L.) except *Achillea millefolium* L., where the highest yields were found in the first year of experiment. The first year of experiment (2003) was validated with a warm and very dry season. Weather status on this locality negatively influences the yields, however higher daily temperatures positively influenced the content of essential oil in the drug. The highest contents of essential oil were measured in the air-dried drug during first season, except *Achillea millefolium* L. and *Melissa officinalis* L. Yields in the first season could be affected because of first year of cultivation of the perennial medicinal plants (exception *Calendula officinalis* L.).

Average yields of *Melissa officinalis* L. cultivated in comparable conditions used to be obtained from 1 500 to 4 000 kg.ha<sup>-1</sup> (Habán, 2004). Results from this locality correspond to the results reported by Vaverkova et al. (2002). According to the quality requirements (SL 1, 2001), the lowest acceptable content of the essential oil in *Melissa officinalis folium* is 0.07 % (V/m). The content of essential oil in *Melissa officinalis folium*

in the experimental locality was 0.25. The lowest yield was recorded by *Salvia officinalis* L. within all cultivated medicinal plant species in the first year of experiment: 1 335.3 kg.ha<sup>-1</sup>, however the content of essential oil remained the highest – 17 ml, respectively 1.7 % V/m. The highest yield was measured generally in the second year of experiment (2004): 1 910 kg.ha<sup>-1</sup>, while the content of essential oil was lower in comparison to the year 2003 – 15 ml, respectively: 1.5 % V/m. In the last experimental season – 2005 the yield was 1 368.3 kg.ha<sup>-1</sup> with equal content of essential oil as in the previous year: 15 ml. Drug yields of Sage obtained during the period are comparable to the yields reached in similar agro-ecological conditions. Some authors (Vaverkova et al., 1994; Sustrikova et al., 2003; Haban, 2004) reported an average yields of Sage 1 000 – 3 000 kg.ha<sup>-1</sup>. The average yield of Sage in our experiment was 1 537.8 kg.ha<sup>-1</sup> with average content of essential oil 15.6 ml, respectively 1.56 %. The content of essential oil in Sage according to different authors can varied between 1.5 – 2.5 % (Bernath, 1991; Maksimovic et al., 1999). The basic quality requirements of Sage drug insist at least 1.0 % V/m (SFK 1, 1997), respectively 1.5 % V/m (ČSL 4, 1987) to appropriate for processing. From these requirements point of view our results confirmed suitable drug quality to herbal teas production. White Yarrow obtained the highest yield of raw material in same growing conditions. This medicinal

plant belongs to the plants that have high potential to utilize soil humidity as well as rainfall water even during drier seasons. At the same time this plant belongs to the low demanding plants from the soil properties point of view (Gromova et al., 1993).

The quality of raw material – air-dried drug – within all of these organically cultivated medicinal

plants met the requirements determined to such types of products. This material can be used as an organically certified product. During all of these experimental years the quality requirements were fulfilled and all products were used to produce herbal teas marked as a bio-product.

## Conclusions

After three years of experiments in organic production of selected medicinal plants: Peppermint (*Mentha x piperita* L.), Pot Marigold (*Calendula officinalis* L.), White Yarrow, (*Achillea millefolium* L.), Lemon Balm (*Melissa officinalis* L.) and Sage (*Salvia officinalis* L.) it is possible to formulate these conclusions: (1) The lowest yields were recorded in the first year of experiment almost within all cultivated medicinal plant species (*Mentha x piperita* L., *Calendula officinalis* L., *Melissa officinalis* L., *Salvia officinalis* L.) except *Achillea millefolium* L., which obtain the highest

yield in the first year (2003). This first year was validated as a warm and very dry year. (2) Significantly higher yields were measured in second and third year of cultivation. (3) Development of weather conditions at the locality highly influenced yields, however higher air temperatures during season positively affected content of an active ingredient – essential oil in the air-dried drug. (4) After the research, analysis and processing tests of these drugs, it is proposed an innovation of organic herbal tea produced from bio-products of certified organic farming.

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