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MORPHOLOGICAL CHARACTERS OF *HYSSOPUS OFFICINALIS* L. AND CHEMICAL COMPOSITION OF ITS ESSENTIAL OIL

Grażyna Zawiślak

Abstract. Hyssop is grown on plantations in Poland. The aim of present study was to investigate the morphological character of *Hyssopus officinalis* and chemical composition of essential oil from hyssop. The plants were cut in the middle of August. Hyssop plants achieved mean height of 41.8 cm and the diameter of 37.1 cm. Main components of hyssop essential oil were: cis-pinocamphone, trans-pinocamphone, *β*-pinene, elemol and germacrene D.

Key words: *Hyssopus officinalis*, yield, oil, cis-pinocamphone, trans-pinocamphone, β-pinene, elemol, germacrene D

Department of Vegetable Crops and Medicinal Plants, University of Life Science in Lublin, 58 Leszczyńskiego, 20-068 Lublin, Poland; grazyna.zawislak@up.lublin.pl

Introduction

Hyssop (*Hyssopus officinalis* L., Lamiaceae) occurs in natural habitats in Europe, Asia, and America (Ram *et. al* 2002). In Poland, hyssop is grown on plantations (Zawiślak 2011). The herbal raw material is the hyssop herb (*Hyssopi herba*) (Strzelecka & Kowalski 2000). The aim of present study was to investigate the morphological character of *H. officinalis* and chemical composition of its essential oil.

Material and methods

The study was carried out during 2007-2008 in The Experimental Farm of Department of Vegetable and Medicinal Plants, University of Life Sciences in Lublin. Hyssop seedlings were produced in a greenhouse. The plants were planted in the field in the middle of May at 30×40 cm spacing. The plants were cut in the middle of August at the height of 8 cm above ground. The herb was dried in a drying oven at a temperature of 30°C. The whole dried herb was ground through 4-5 mm mesh sieves, thereby obtaining the ground herb. The ground herb was used to extract hyssop oil by steam distillation (Polish Pharmacopoeia VII 2006).

Analysis of essentials oil:

GC-MS

The GC-MS instrument ITMS Varian 4000 GC-MS/MS (Varian, USA) was used, equipped with a CP-8410 auto-injector and a 30 m × 0.25 mm i.d. VF-5ms column (Varian, USA), film thickness 0.25μm; carrier gas, helium at a rate of 0.5 ml/min; injector and detector temperature, 220°C and 200°C, respectively; split ratio, 1:20; injection volume, 1 μl. A temperature gradient was applied (60°C for 0.5 min, then incremented by 3°C/min to 246°C and held at this temperature for 10 min); ionization energy, 70 eV; mass range, 40-1000 Da; scan time, 0.80 s.

GC-FID

A Varian 3800 Series (Varian, USA) instrument with a DB-5 column (J&W, USA) was used, operated under the same conditions as GC-MS; FID, 256oC; split ratio 1:50.

The qualitative analysis was carried out on the basis of MS spectra, which were compared with the spectra of the NIST library (Mass Spectral Library 2002) and with data available in the literature (Adams 2001). The identity of the compounds was confirmed by their retention indices, taken from the literature (Adams 2001).

Results and discussion

Average monthly air temperatures from May to August in 2007 and 2008 were close to the

Table 1. Air temperature and total precipitation in 2007 and 2008 years against a background of long-term averages.

Temperature (°C)									
Month	2007				2008				1951-2005
	decade			Mean	decade			Mean	
	I	II	III		I	II	III		
V	9.9	15.1	19.6	14.9	11.3	13.3	13.6	12.7	13.0
VI	18.2	20.0	16.2	18.1	18.0	16.4	18.8	17.7	16.5
VII	17.1	21.0	19.3	19.1	17.1	18.9	18.9	18.3	17.8
VIII	17.9	18.9	18.4	18.4	19.9	20.7	17.3	19.3	17.1
Precipitation (mm)									
Month	2007				2008				1951-2005
	decade			Σ	decade			Σ	
	I	II	III		I	II	III		
V	13.5	29.9	37.1	80.5	57.1	34.7	9.8	101.6	57.7
VI	52.4	25.4	10.0	87.8	0.0	19.6	6.3	25.9	65.7
VII	48.8	35.0	3.2	87.0	39.6	19.3	18.2	77.1	83.5
VIII	22.3	12.9	2.4	37.6	11.4	7.0	26.6	45.0	68.6

Table 2. Morphological features and yield of *Hyssopus officinalis.*

Years	Plant height (cm)	Plant diameter (cm)	Number of main branches (pcs · plant^{-1})	Yield of fresh herb (kg · m^{-2})	Yield of dry herb (kg · m^{-2})	Yield of grated herb (kg · m^{-2})	Essential oil (%)
2007	43.5	38.9	19.7	1.8	0.4	0.2	1.5
2008	40,1	35.4	24.2	1.2	0.3	0.1	1.6
Mean	41.8	37.1	21.9	1.5	0.3	0.1	1.5

long-term average temperatures (Tab. 1). Total precipitation in May 2007 and 2008 was higher than the long-term average precipitation. In June 2007 rainfalls were more than three times higher than in 2008. No differences were observed in plant growth in spite of the fact that, as reported by WOLSKI *et al.* (2006), hyssop is a plant that grows well in dry areas.

On the basis of the performed measurements it was demonstrated that hyssop plants achieved mean height of 41.8 cm and the diameter of 37.1 cm. The number of main shoots was 21.9 pcs · plant^{-1} on average (Tab. 2). Studies conducted by ROSŁON *et al.* (2002) revealed that *H. officinalis* plants in full bloom achieved the height of 70 cm. Thus, they were higher than those examined in the experiment. In the observations conducted by MARTYNIAK-PRZYBYSZEWSKA (2005) the height of hyssop plants in August was 51.2 cm on average.

The yield of fresh herb, yield of dry and grated herb was the highest from plants cultivated in the year 2007 and equaled, respectively: 1.8 kg · m^{-2}, 0.4 kg · m^{-2} and 0.2 kg · m^{-2}.

The content of essential oil was 1.5% on average. In the studies by ROSŁON *et al.* (2002) the content of oil in blooming period did not exceed 1%. WOLSKI *et al.* (2006) report that the most oil is contained in hyssop flowers and leaves.

The chemical composition of essential oil in herbal plants depends on the place of origin of raw material (WESOŁOWSKA *et al.* 2010). A study showed the presence of 45 compounds in hyssop oil, among which 1 was not identified. Main components of hyssop

Table 3. Chemical composition of essentials oil in *Hyssopus officinalis* (> 2.0%).

Year	Compounds
2007	cis-pinocamphone (33.52%), trans-pinocamphone (28.67%), *β*-pinene (8.12%), elemol (5.86%), germacrene D (3.23%), *E*-caryophyllene, (2.67%), *β*-phellandrene (2.54%), sabinene (2.08%).
2008	cis-pinocamphone (37.13), trans-pinocamphone (23.43%), elemol (8.95%), *β*-pinene (7.89%), germacrene D (4.65%), *β*-phellandrene (2.17%), myrtenol (2.11%).

essential oil were: cis-pinocamphone (33.52-37.13%), trans-pinocamphone (23.43-28.67%), *β*-pinene (7.89-8.12%), elemol (5.86-8.95%) and germacrene D (3.23-4.65%) (Tab. 3). Cis-pinocamphone and trans-pinocamphone were the dominant constituents in hyssop oil in the studies of Mitić & Dordević (2000), Rey *et al.* (2004) and Zheljazkov *et al.* (2012). Mitić & Dordević (2000) showed the content of cis-pinocamphone to be at a level of 44.7%, whereas the content of trans-pinocamphone was lower (14.1%) than in the present study.

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