

Yield and quality of herb in five populations of stinging nettle (*Urtica dioica* L.)

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Summary

The aim of the present study was evaluation of the yield and quality of herb in five wild growing populations of stinging nettle. The dioecism of this plant was taken under consideration. Herb was harvested at the beginning of blooming, at the full blooming stage and at the end of vegetation. Fresh and dry mass of herb, as well as the content of chlorophyll, flavonoids and phenolic acids in dry raw material were determined. Significant differences between populations and between male and female forms were observed. The „Kabaty” population was characterized by the higher mass of herb, whereas „Bielany” by the highest content of chlorophyll and phenolic acids in herb. The male form was characterized by higher mass of herb as well as higher content of flavonoids in comparison with female form.

Key words: stinging nettle, chlorophyll, flavonoids, phenolic acids

INTRODUCTION

Stinging nettle is a well known and important medical plant. Herb, leaves and underground organs of this plant indicate many pharmacological activities: improving metabolism, diuretic, detoxicant, anti-inflammatory, analgesic, immunostimulating, antioxidant and many others [1-4].

Raw material of stinging nettle is especially being obtained from natural sites. This fact can be one of reasons of variable quality of obtained raw. Chemical differences between male and female forms of stinging nettle were also observed [5, 6].

The aim of the present work was to determine intra-specific variability of stinging nettle, especially according to biologically active compounds content.

MATERIALS AND METHODS

The experiment was carried out on the experimental field of the Department of Vegetables and Medicinal Plants of Warsaw Agricultural University. Seeds of 5 wild growing populations from natural sites located near Warsaw („Kabaty”, „Młociny”, „Izabelin”, „Mokotów”, „Bielany”) were collected in 2004. The seeds were sown in the greenhouse in February 2005 and 2006. Seedlings were planted out in the middle April at the spacing of 50 x 50 cm, 100 plants for each population. The objects of investigation were one-year-old plants. The dimorphic nature of stinging nettle was taken under consideration. Three harvest times were applied: in the first decade of July (the beginning of blooming), first decade of August (full blooming phase) and first decade of September (the end of vegetation). The herb was cut from 30 plants of each population, at each harvest time. After harvesting the fresh weight of herb was determined. The dry mass was measured after drying at the temperature of 45°C.

The content of chlorophyll, flavonoids and phenolic acids was determined in dry raw material. The content of chlorophyll was determined using the Lichtenthaler Welbyrn method [7], while content of flavonoids and phenolic acids according to Farmacopoea Polska VI [8]. Presented results were mean values obtained in two years and were subjected to statistical analysis using the STATGRAPHICS PLUS program. The significance of differences between values was estimated by t-student test with $\alpha=0.05$ or 0.01.

RESULTS AND DISCUSSION

Previous researches show that there is a diversity as to the developmental and chemical traits of plants belonging to *Urtica* species [6, 9]. This kind of variability is observed between plants originated from different natural sites as well as between male and female forms of stinging nettle [10].

In the present work the mass and content of selected biologically active compounds in herb of five stinging nettle populations growing under *ex situ* conditions were determined. Investigated populations differed significantly as to fresh and dry mass of herb (Tables 1 and 2). Fresh herb mass ranged from 316.67 (population „Bielany”) to 551.11 g/plant (population „Kabaty”) and dry mass from 115.58 to 170.54 g/plant, respectively. The male form was characterized by higher mass of herb than female form at each harvest time and in every population. The highest mass of herb was observed for plants harvested in September (3rd harvest time). The male form of stinging nettle had more leaves than female form. The leaves share (68.5%, on average) in herb at first harvest (July) was higher than in second harvest (August).

The herb of stinging nettle is a raw material used in industry to obtain chlorophyll [11]. The content of chlorophyll depends both on the form of plants and harvest time.

Table 1.

The fresh mass of herb (g/plant).

harvest time		1 st harvest		2 nd harvest		3 rd harvest	
population	form	male	female	male	female	male	female
	Kabaty		363.33	283.33	563.33	400.00	1020.00
Młociny		255.00	210.00	535.00	280.00	716.00	532.67
Izabelin		240.00	168.33	466.67	346.67	491.67	398.33
Mokotów		235.00	151.67	513.33	240.00	523.33	366.67
Bielany		148.33	121.67	430.00	271.67	516.67	411.67

NIR_{0.05} (A) population – 83.76, (B) form – 37.67, (C) harvest time – 55.43 (A/BC) – 205.17, (B/AC) – 145.89, (C/AB) – 175.27

Table 2.

The dry mass of herb (g/plant).

harvest time		1 st harvest		2 nd harvest		3 rd harvest	
population	form	male	female	male	female	male	female
	Kabaty		98.50	78.00	137.73	100.57	351.17
Młociny		69.53	63.83	146.13	73.50	294.67	205.93
Izabelin		64.53	48.30	161.50	134.23	218.90	172.27
Mokotów		65.97	43.73	145.00	67.37	191.50	188.70
Bielany		41.60	35.67	107.97	76.03	234.43	197.77

NIR_{0.05} (A) population – 32.06, (B) form – 14.42, (C) harvest time – 21.21, (A/BC) – 78.52, (B/AC) – 55.83, (C/AB) – 67.08

Plants of „Kabaty” population was characterized by the highest content of chlorophyll a and b in herb ($3.33 \text{ mg} \times \text{g}^{-1}$, on average) when plants of „Młociny” by the lowest. Female form had a higher content of this pigment than the male one when harvested in July. However, when the harvest took place in August and September more chlorophyll was observed in the male form. Obtained results show that content of this pigment in herb of investigated plants decreased during the vegetation period (Tables 3 and 4).

Table 3.

The content of chlorophyll a in dry herb [$\text{mg} \times \text{g}^{-1}$].

harvest time		1 st harvest		2 nd harvest		3 rd harvest	
population	form	male	female	male	female	male	female
	Kabaty		3.17	3.57	2.20	1.80	2.27
Młociny		2.52	3.03	2.07	1.43	2.30	1.70
Izabelin		2.77	3.23	1.67	1.50	2.40	2.07
Mokotów		2.40	3.57	1.87	1.40	2.43	1.43
Bielany		2.97	3.27	1.77	1.53	2.53	2.43

NIR_{0.01} (A) population – 0.36, (B) form – 0.16, (C) harvest time – 0.24 (A/BC) – 0.88, (B/AC) – 0.62, (C/AB) – 0.75

Table 4.

The content of chlorophyll b in dry herb [mg x g⁻¹].

population	harvest time form	1 st harvest		2 nd harvest		3 rd harvest	
		male	female	male	female	male	female
Kabaty		1.17	1.33	0.27	0.09	0.87	0.87
Młociny		0.90	1.10	0.27	0.09	0.77	0.60
Izabelin		0.93	1.17	0.15	0.17	0.63	0.60
Mokotów		0.87	1.27	0.30	0.15	0.90	0.60
Bielany		1.13	1.23	0.27	0.16	1.43	0.73

NIR_{0.01} (A) population – 0.28, (B) form – 0.13, (C) harvest time – 0.18 (A/BC) – 0.68, (B/AC) – 0.8, (C/AB) – 0.8

Other important groups of biologically active compounds are flavonoids and phenolic acids. They reveal many pharmacological activities: antioxidant, antimicrobial, analgesic and antitumor [3, 12]. There were no significant difference between populations „Kabaty”, „Młociny”, „Izabelin” i „Bielany” as to the content of flavonoids in herb (Table 5). Population „Mokotów” was characterized by the smallest content of these compounds (0.42%, on average). Significant differences in the flavonoids content were also observed between male and female form. More these compounds were present in the leaves of male form in comparison to female, what was found earlier by Węglarz and Karaczun [10] and Roson [6]. The content of flavonoids increased during the vegetation up to September (3rd harvest time). Investigated populations differed also as to the content of phenolic acids (Table 6). Population „Bielany” was characterized by the highest content of these compounds and population „Młociny” by the smallest. Higher content of phenolic acids was observed in herb of male form in comparison to female. The highest content of these compounds was present in herb harvested in August (2nd harvest time).

Table 5.

The content of flavonoids in dry herb [%].

population	harvest time form	1 st harvest		2 nd harvest		3 rd harvest	
		male	female	male	female	male	female
Kabaty		0.31	0.23	0.41	0.58	0.62	0.58
Młociny		0.31	0.28	0.54	0.51	0.54	0.48
Izabelin		0.36	0.25	0.46	0.48	0.64	0.60
Mokotów		0.29	0.28	0.48	0.47	0.57	0.41
Bielany		0.35	0.35	0.52	0.49	0.57	0.50

NIR_{0.01} (A) population – 0.03, (B) form – 0.01, (C) harvest time – 0.02 (A/BC) – 0.08, (B/AC) – 0.06, (C/AB) – 0.07

Table 6.

The content of phenolic acids in dry herb [%].

population	harvest time form	1 st harvest		2 nd harvest		3 rd harvest	
		male	female	male	female	male	female
Kabaty		0.70	0.57	0.78	0.68	0.68	0.54
Młociny		0.62	0.46	0.71	0.63	0.59	0.52
Izabelin		0.82	0.42	0.85	0.66	0.55	0.50
Mokotów		0.74	0.37	0.81	0.57	0.66	0.52
Bielany		0.85	0.69	0.86	0.81	0.72	0.69

NIR_{0.01} (A) population – 0.02, (B) form – 0.01, (C) harvest time – 0.02 (A/BC) – 0.06, (B/AC) – 0.04, (C/AB) – 0.05

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OCENA PŁONOWANIA I JAKOŚCI ZIELA PIĘCIU DZIKO ROSNĄCYCH POPULACJI
POKRZYWY ZWYCZAJNEJ (*URTICA DIOICA* L.)

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Streszczenie

Celem badań była ocena plonowania i jakości ziela pięciu dziko rosnących populacji pokrzywy zwyczajnej. W doświadczeniach uwzględniono dwupiennosc gatunku. Zbiór surowca prowadzono w trzech fazach rozwojowych roślin (początek kwitnienia, pełnia kwitnienia, koniec kwitnienia). Po zbiorze określono świeżą i powietrznie suchą masę ziela.

W suchym surowcu określono zawartość chlorofilu, flawonoidów i kwasów polifenolowych. Stwierdzono istotne różnice pomiędzy populacjami, a także męską i żeńską formą pokrzywy. Z populacji „Kabaty” uzyskano najwyższą masę ziela, natomiast rośliny populacji „Bielany” okazały się najbogatsze w chlorofil i polifenolokwasy. W przypadku formy męskiej uzyskano wyższą masę ziela. Forma ta zawierała też więcej flawonoidów.

Słowa kluczowe: pokrzywa zwyczajna, chlorofil, flawonoidy, polifenolokwasy.