# ACCUMULATION OF PHENOLIC COMPOUNDS IN LEAVES AND UNDERGROUND ORGANS OF DROPWORT (*FILIPENDULA VULGARIS* MOENCH)

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## Introduction

*Filipendula vulgaris (Rosaceae)* grows rarely in Europe and Asia on dry nonacidic grasslands and neglectedlands. It is perennial with shoots up to 80 cm high and pinkish-white flowers gathered in many-flowered inflorescences. The June and July is the period of plant blooming. Underground organs of this plant are rhizomes and roots with tubers (Smolarz and Sokołowska – Woźniak, 2001; Weidema et al., 2000; Clapham et al., 1987). The herb and underground parts of *F. vulgaris* have been used in folk medicine as raw materials with anti-inflammatory, antipyretic, analgetic and antirheumatic properties. The herb was traditionally used in a similar way as *Filipendula ulmaria* (meadowsweet), whereas underground organs are utilized to treat kidney problems, breathlessness, wheezing, sore throat and congestion. Due to the higher content of tannins in comparison to *F. ulmaria*, *F. vulgaris* is frequently use to treat stomachache and diarrhea (Pavlovic et al., 2007; Radulović et al., 2007; Smolarz and Sokołowska–Woźniak, 2001; Tucakov, 1973).

The aim of our study was to investigate the effect of *F. vulgaris* flowering shoots removal in the second year of plant vegetation on the yield of basal leaves and underground organs (rhizomes with tuberous roots) and accumulation of phenolic compounds in these organs.

## Materials and methods

The experiment was carried out at the fields of the Department of Vegetable and Medicinal Plants of the Warsaw University of Life Sciences-SGGW. The seeds of *F. vulgaris*, collected from natural sites from Podlasie region in Poland, were sown in the glasshouse in March 2007 and 2008. The seedlings were planted out in May, in spacing 50 × 30 cm. For chemical evaluation plant materials (rhizomes, tubers, roots and leaves) were collected in October of 2008 and 2009 from two-years-old plants after flowering shoots removal (at the end of June) and from plants not-cut. The results are mean values from 10 plants. For the determination of biologically active compounds high liquid chromatography (HPLC) was applied.




## References

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## Results

The flowering shoots removal increased significantly the yield of leaves and underground organs of two-year-old plants. The mass of underground organs was diversified. The mass of tubers was distinctly higher (126.7 g per plant) in comparison with rhizomes and roots. The mass of autumn basal leaves was comparable with the mass of rhizomes (Fig. 1).

Catechin derivatives ((-)-epigallocatechin, (+)-catechin, (-)-epicatechin, (-)-epigallocatechin gallate) and phenolic acids (ellagic and gallic acids) were found in the underground organs, whereas (-)-epicatechin, phenolic acids (ellagic, gallic, chlorogenic and caffeic acids) and flavonoids (hyperoside, astragalin, spireoside,kaempferol)–intheleaves (Tables 1-4). Previous studies on *F. vulgaris* showed the presence of tannins, phenolic acids, flavonoids and traces of coumarin both in the herb and underground parts of this plant (Pavlović et al., 2007; Smolarz et al., 1999; Sokołowska-Woźniak, 1998; Lamaison et al., 1992).

In our study the dominant compounds in the leaves were hyperoside, (-)-epicatechin and gallic acid and in underground organs – catechin derivatives ((+)-catechin and (-)-epicatechin). The summer removal of flowering shoots changed the content of determined phenolic compounds in raw materials collected in the late autumn. The storage organs (rhizomes and tubers) from the plants subjected to flowering shoots removal were characterized by distinctly lower content of these compounds in comparison to raw materials from not-cut plants. Especially rich source of (+)-catechin and (-)-epicatechin appeared to be rhizomes (571.3 and 348.5 mg×100g$^{-1}$, respectively) (Tables 1 and 2). The content of tannins and phenolic acids in the leaves and roots of not-cut plants was lower than in the plants after flowering shoots removal. Shoots removal did not affected the content of flavonoids in the leaves (Tables 3 and 4).

Table 1. The content of phenolic compounds in rhizomes [mg × 100g$^{-1}$]

| | Not-cut plants | Cut plants |
|---|---|---|
| (-)-Epigallocatechin | 295.90** | 238.60 |
| (+)-Catechin | 571.30** | 351.50 |
| (-)-Epicatechin | 348.50** | 270.40 |
| (-)-Epicatechin gallate | 198.20** | 105.40 |
| Ellagic acid | 37.40** | 20.70 |
| Gallic acid | 89.40** | 71.10 |

Table 2. The content of phenolic compounds in tubers [mg × 100g$^{-1}$]

| | Not-cut plants | Cut plants |
|---|---|---|
| (-)-Epigallocatechin | 205.90** | 101.40 |
| (+)-Catechin | 260.30** | 112.80 |
| (-)-Epicatechin | 164.50** | 86.900 |
| (-)-Epicatechin gallate | 21.60** | 0.00 |
| Ellagic acid | 18.50** | 4.60 |
| Gallic acid | 128.40** | 32.50 |

Table 3. The content of phenolic compounds in roots [mg × 100g$^{-1}$]

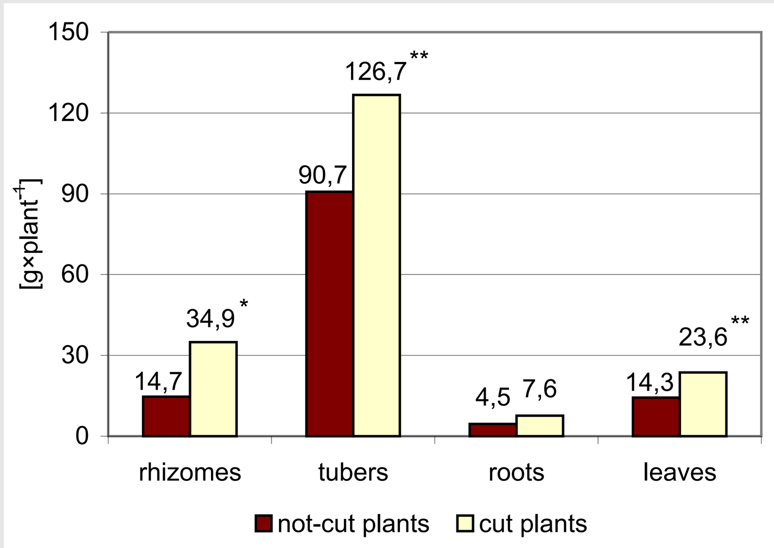
| | Not-cut plants | Cut plants |
|---|---|---|
| (-)-Epigallocatechin | 113.70 | 168.30** |
| (+)-Catechin | 268.90 | 288.90 |
| (-)-Epicatechin | 236.90 | 232.30 |
| (-)-Epicatechin gallate | 23.50 | 38.30** |
| Ellagic acid | 10.40 | 25.70** |
| Gallic acid | 31.20 | 64.50** |

**p.<0,01

Table 4. The content of phenolic compounds in leaves [mg × 100g$^{-1}$]

| | Not-cut plants | Cut plants |
|---|---|---|
| (-)-Epicatechin | 175.30 | 168.90 |
| Ellagic acid | 14.90 | 19.10 |
| Gallic acid | 116.70 | 158.10** |
| Chlorogenic acid | 58.30 | 106.30** |
| Caffeic acid | 47.30 | 51.60 |
| Hyperoside | 372.21 | 389.70 |
| Astragalin | 47.30 | 32.40 |
| Spireoside | 10.28 | 10.66 |
| Kaempferol | 13.90 | 12.20 |

Fig. 1. Dry mass of raw materials [g × plant$^{-1}$]




Underground organs (rhizomes with tuberous roots)

## Conclusions

The summer flowering shoots removal affected plant growth and accumulation of phenolic compounds in the second year of vegetation of *F. vulgaris*. This treatment resulted in the increase of the mass of both above- and underground organs. In the underground organs the content of catechin derivatives and phenolic acids was distinctly lower in plants subjected to summer removal of flowering shoots. There was not clear relationship between shoot removal and the content of phenolic compounds in the autumn basal leaves.