

# Abstract

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Title of Doctoral Thesis: Phytochemical study of individual plant species of *Bergenia* genus

*Bergenia*, native to central Asia, is promising source of medicinal compounds mainly in the system of Chinese and Indian traditional medicine. These species have been used for centuries in therapy of various diseases. They are valued for their ability to dissolve kidney or bladder stones. *Bergenia* plants are used for therapy of pulmonary diseases and cold. They have demonstrated antioxidant, antibacterial, antiviral, immunostimulant, anti-inflammatory, anticancer, antidiabetic, antitussive, hepatoprotective and diuretic effects.

The main aim of this thesis was to determine the content of secondary metabolites (arbutin, total polyphenols, bergenin and anthocyanins) in three taxons of *Bergenia* genus - *Bergenia crassifolia* (L.) Fritsch, *Bergenia ciliata* (Haw.) Sternb. a *Bergenia* x *ornata* Stein., to compare their biological activities and to identify the most appropriate kind of *Bergenia* plants with the greatest potential for use in therapy. Plant hybrid *B. x ornata* was evaluated on the content of phenolic compounds and biological activity for the first time. *Bergenia* leaf extracts were tested for antioxidant, antiradical, tyrosinase, antiparasitic, immunostimulating, anti-platelet activity and its ability to inhibit the enzyme COX-1 and the formation of PGH<sub>2</sub>.

The contents of arbutin, total polyphenols, anthocyanins and bergenin (in  $\text{mg}\cdot\text{g}^{-1}$  of dry weight DW) were determined in the extracts of green and red leaves of *Bergenia* plants. The highest content of phenolic glycoside arbutin in the leaves of *B. crassifolia* ( $58,85 \pm 0,71 \text{ mg}\cdot\text{g}^{-1}$  DW) and *B. x ornata* ( $51,04 \pm 1,21 \text{ mg}\cdot\text{g}^{-1}$  DW) was found. The highest content of total polyphenols in *B. x ornata* ( $49,36 \pm 1,31 \text{ mg}\cdot\text{g}^{-1}$  DW) and *B. crassifolia* ( $48,74 \pm 1,14 \text{ mg}\cdot\text{g}^{-1}$  DW) was detected. The highest total amount of bergenin in the leaves of *B. x ornata* ( $6,23 \pm 0,09 \text{ mg}\cdot\text{g}^{-1}$  DW) was revealed. The anthocyanins were also determined in the red leaves of *Bergenia* (from  $5,41 (\pm 0,06)$  to  $8,30 (\pm 0,08) \text{ mg C3G}\cdot\text{g}^{-1}$  DW). The highest amount of polyphenols, bergenin and arbutin in leaf samples collected in autumn was found. The content of secondary metabolites correlated significantly with the meteorological data (mainly with relative humidity and water precipitation).

Significant positive correlations between phenolic contents and results from the measurement of antiradical and antioxidant activity (by methods DPPH, ABTS, NADH, FRAP) were demonstrated. Higher content of arbutin, polyphenols, bergenin and anthocyanins of the tested samples during autumn correlated with the higher antioxidant activity. The highest correlation was obtained for *B. crassifolia*. Great percentage content of phenolic compounds is responsible for the radical scavenging activity. Anthocyanins in red leaves are responsible for the antioxidant activity as well.

Ethanol extracts of *Bergenia* proved the ability to inhibit the activity of mushroom tyrosinase. But the correlation dependence between the total amount of arbutin and inhibiting activity of tyrosinase has not been significant. Antiparasitic activity was tested on the larvae of flat worms *Mesocostoides vogae*. Larvicidal activity of bergenin, arbutin and *Bergenia* extracts has not been established. Tested biological substances encouraged metabolism and viability of

larvae conversely (mainly aqueous extract of *B. crassifolia* and arbutin). The relationship between metabolic activity and the amount of total lipids in the larvae was also revealed.

Lymphocytes were markedly activated (as measured by CD69 expression) by ethanolic extracts of *B. x ornata* in concentration of 3,13 and 6,25 mg.ml<sup>-1</sup>, as revealed in the immunostimulatory assay. Antiplatelet activity was proved for bergenin (41,64 ± 0,97 %) and aqueous extract of *B. x ornata*, which significantly reduced the platelet aggregation up to 28,53 ± 0,96 % and was effective in analogy with acetylsalicylic acid (24,17 ± 1,02 %). The same extract was active in the inhibition of cyclooxygenase (COX-1). *B. x ornata* extract demonstrated the ability to inhibit the production of prostaglandin PGH<sub>2</sub> up to 60,68 ± 1,05 %.