Skin lesions caused by ivy (Hedera helix L.) leaves

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Abstract:
Hedera helix leaves are a medicinal raw material with toxic properties related to the content of triterpene saponins. The rationale behind the anatomical analyses of ivy leaves conducted in the present study was a case of skin lesions triggered by contact with the plant while gardening and a need to find its cause. In microscopic studies, we have determined the location of secretory tissues and analysed their content with the use of histochemical assays. We have demonstrated that essential oil is produced by glandular trichomes and secretory channels located close to vascular bundles. We have found that the epidermis cell secretion, which can evoke reaction, is present not only in the trichomes but also on the surface of leaf blades and petioles.

Key words: common ivy, toxic plant, skin lesions, saponins

Introduction

The common ivy (*Hedera helix* L.) from the family Araliaceae is a climbing shrub (fig. 1) with 20–30 m long shoots. Its climbing around tree trunks and branches is facilitated by adventitious roots growing abundantly along the stem. In natural habitats, it also grows on the soil surface forming dense carpets [1].

The leathery, shiny, and evergreen ivy leaves show resistance to frost. They are characterised by various shapes and sizes. Younger plants produce three- or five-lobed leaves (fig. 2), whereas older plants have ovate or rhomboid leaves with an entire margin on flower shoots (fig. 3). Ivy flowers in September and October. The pentamerous flowers form a corymbothyrsus. The corolla is yellow-green inside and brown outside. The fruit is a blue-black spherical berry [3].

In Poland, the common ivy grows in deciduous forests and in lower mountainous locations. The occurrence range of this plant species covers the entire area of Europe except Scandinavia. The eastern boundary of the geographical range is located in Poland [2]. *H. helix* has been protected in Poland for many years but is not protected at present.

Figure 1. *Ivy shoots hanging around a tree trunk.*

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Figure 2. *Apical part of an ivy shoot with young pubescent leaves and a pubescent stem.*

Figure 3. *Ivy shoots flowering in September.*

The common ivy is also grown as an ornamental species planted on flowerbeds, pergolas, and terraces in shady locations. The decorative properties of the plant were valued as early as in antiquity, as it played an important role in the cult of Dionysus, who was depicted in an ivy wreath on the head [1]. The common ivy is also a medicinal [2, 4], cosmetic [5, 6], and nectariferous [7] plant. Ivy leaves serve as a medicinal raw material (*Folium Hederae*) due to its content of triterpene saponins, flavonoids, tannins, phenolic acids, resins, and essential oil [8, 9].

Ivy leaves are used for production of expectorants [4, 10–12] and exhibit spasmolytic and antifungal activity [4, 9, 12]. The plant material is applied in treatment of infections upper respiratory tract, as a choleretic and anti-inflammatory agent, and in treatment of hyperthyroidism [13]. Ivy extracts are used in atherosclerosis therapy, as they contribute to decomposition of fats and are useful in alleviation of degenerative changes in vascular walls [14].

The leaves are also a cosmetic raw material. Leaf infusions are used for treatment of dandruff and other skin diseases [15]. Stabilised extracts are applied in production of creams and lotions [5]. The leaf material is a component of cosmetics used to fight cellulite and excessive subcutaneous fat tissue [14, 15]. It also exerts anti-varicose effects [8].

This abundant producer of nectar is highly valued as a food source for insects in early autumn when only few species produce flowers [7, 16].

The triterpene saponins contained in ivy leaves and mainly in fruits have toxic properties. When consumed, both fruits and leaves can cause poisoning manifested by mouth and throat burning, diarrhoea, partial loss of consciousness, hallucinations, convulsions, accelerated pulse, and fever. Death cases have been reported as well [17, 18]. Contact with the plant can induce allergic reactions, i.e. rash and skin inflammation, in susceptible individuals [11, 18, 19].

Aim

The aim of the study was to determine the location of selected secondary metabolites in the tissues of *Hedera helix* leaves and on the surface of the epidermis of these organs using microscopic methods.

Material and method

The botanical analyses were performed on leaves of the common ivy (*Hedera helix* L.) from the family Araliaceae collected in the Botanical Garden UMCS in Lublin. Epidermis structures were analysed in sections tangential to the surface of petioles. Cross-sections were used for analyses of the internal leaf tissues. The examinations were carried out using light and fluorescence microscopy. Autofluorescence of plant tissues was analysed using an FITC filter (EXP. 465-495, DM 505; BA 515-555).

We also carried out histochemical assays to detect tannins, phenolic compounds, and essential oils.

Results and discussion

The skin lesions (fig. 4) were observed in a young female after contact with ivy shoots which she

had arranged around the pergola. A few hours later, vesicles filled with secretion followed by surrounding red patches appeared on the skin of the arms and forearms. The patches enlarged at exposure to sunlight. After 10 days, the vesicles decreased and dried up. Spots left by the vesicles and smaller patches persisted for another 4 weeks. After this period, they were hardly visible but reappeared after sun exposure.

The botanical studies carried out with the use of fluorescence microscopy and the histochemical assays applied to different leaf tissues revealed a variety of biologically active secondary metabolites. We detected tannins in the epidermis cells, phenolic compounds in the epidermis and palisade parenchyma, as well as resin and essential oil in the vascular bundles. Saponins were present in the trichomes and other epidermis cells. The trichomes represented the non-glandular, multicellular, branched type (fig. 5). The basal cells of these trichomes contained essential oils and phenolic compounds. A fluorescent secretion containing phenolic compounds was also observed on the surface of the epidermal cells of the leaf blade (fig. 6). The skin lesions may have been caused by the secretion of trichomes present on the leaf blades and petioles of young leaves and by the secretion of the epidermis cells, which was visible on their surface (fig. 7).

Some plants contain their sensitising secretion inside secretory trichomes, e.g. in *Dictamnus* [20] or *Heracleum* [21]. It has also been proven that the toxic *Heracleum sosnowskyi* secretion causing photodermatoses can be secreted onto the surface of the leaf and stem epidermis by trichomes and other epidermis cells. It triggers development of skin lesions progressing to large blisters in observed patients [21–23]. Since the leaf secretion in *Hedera helix* is a cause of skin lesions related to hypersensitivity to the ultraviolet part of the solar spectrum in susceptible individuals, it can be classified as an photoallergy inducer, in accordance with the criterion presented by Śpiewak [24].

Conclusions

The secretion of *H. helix* leaves was visible in the microscopic view in the trichomes and on the surface of the leaf blades and petioles, and it can be assumed that the compounds contained therein cause skin reactions. Our observations confirm the data reported by some authors describing reaction to ivy and its products in sensitive individuals [11, 12, 25].

Figure 4. *Skin lesions induced by contact with ivy shoots.*

Figure 5. *Multicellular trichomes from the ivy leaf petiole with secretion in the basal cell (arrows).*

Figure 6. *Cross-section of the ivy leaf blade with autofluorescence of epidermis cells (arrows).*

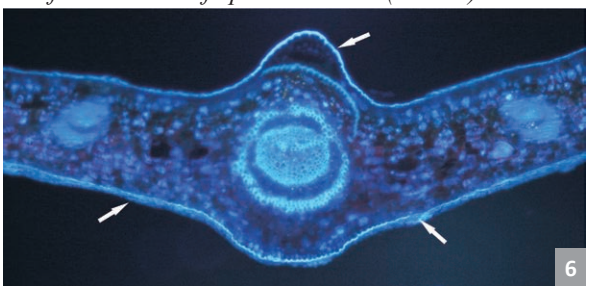
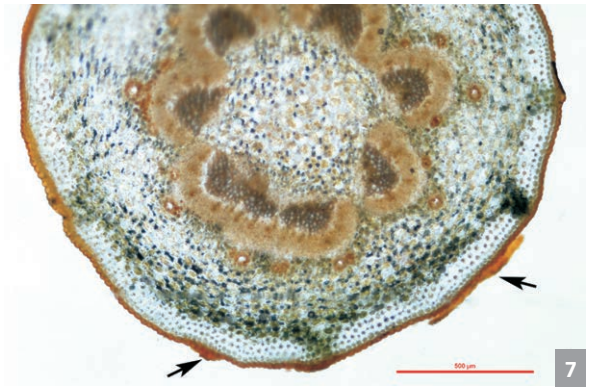


Figure 7. *Cross-section of the ivy leaf petiole with an orange-stained lipid secretion (arrows) visualised by the histochemical assay (Sudan III).*



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