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What Plant Evidence Tells Us

Introduction

When hearing the term "forensic botanist," many people immediately associate it with narcotic plants, primarily hemp. However, forensic botany encompasses far more than that. In this study, I aim to present cases that illustrate another aspect of forensic botany and highlight its potential applications.

Dr. Balázs Kenyeres, forensic medical expert, emphasised the importance of examining plant remains in a study published following the 1912/13 session of the Law and Social Sciences Department of the Transylvanian Museum Society.[1] He mentioned three cases in which the analysis of plant evidence helped solve crimes. The first involved a knife blade on which plant hairs were found; the examination revealed that the weapon had been used to destroy a neighbouring hop plantation. The second case was similar: sawdust found between the teeth of a saw proved that the tool had last been used to cut cherry wood. The third case concerned a murdered landowner, who had been beaten with oak and cherry stakes. During the autopsy, a wood fibre was discovered in the fatal skull fracture. The fibre analysis revealed that the oak stake had caused the lethal injury[2].

[1] Kenyeres, B.: A növényi nyomok jelentősége a bűnügyek felderítésében [The significance of plant traces in criminal investigations]. Erdélyi Múzeum-Egyesület Közleményei. 1913.

[2] Kenyeres, B.: Az orvos-természettudományok a büntetendő cselekmények nyomozásában [The role of medical and natural sciences in the investigation of criminal offences]. Erdélyi Múzeum, V. füzet. Ajtai K. Albert könyvnyomdája. Kolozsvár, 1914. 108–110. o.

Objects subjected to examination in forensic botany may include whole plants, plant parts or fragments, as well as fungi. Any case may yield botanical material as evidence, which can be submitted to the forensic botany laboratory. The case studies presented below all belong to the field of classical criminalistics. Overall, forensic botany is well-suited to complement, support, and reinforce the findings of other forensic disciplines.

Botanists conduct identification and comparative analyses and can also determine the origin or provenance of plant material. For these identification and comparative studies, they rely on reference samples collected by the investigating authorities, on Hungarian and international literature, and on the internal collections of the Hungarian Institute for Forensic Sciences (HIFS). Like other forensic disciplines, forensic botany also has limitations, primarily related to the size and condition of the material under examination.

"Poisoning" in the Kindergarten

A report was received by the County Police Headquarters Operations Control Centre stating that children in the yard of one of the municipal kindergartens had consumed the leaves of plants growing there. Six children were examined in the Pediatric Department of the local hospital; however, no signs of poisoning or clinical symptoms were observed. Nevertheless, criminal proceedings were initiated for suspected negligent endangerment in the course of duty. It was suspected that the children had ingested leaves of the poisonous daffodil (Narcissus sp.). Consequently, the plants and leaves collected from the kindergarten yard were seized by the investigating authority and submitted for botanical analysis at the Hungarian Institute for Forensic Sciences (HIFS) (Figure 1). The authority's primary question was whether the seized plants and leaves truly belonged to poisonous species. Based on external morphological characteristics, the seized plants and plant fragments were identified as specimens or parts of daylily (Hemerocallis sp.), a member of the family Hemerocallidaceae (Figure 2).

Figure 1
Plants tasted by children in the kindergarten yard
Source: Hungarian Institute for Forensic Sciences (hereinafter: HIFS), internal documentation.

Figure 2
Seized plant remains
Source: HIFS, internal documentation.

At first glance, daylilies and daffodils closely resemble each other, but a more detailed examination reveals several distinguishing features. The daylily, a member of the family Hemerocallidaceae, is native to East Asia and Europe. In Hungary, it used to occur in several natural habitats but is now found only in the most secluded areas. It is strictly protected, with a conservation value of 100,000 HUF per individual[3]. The daffodil, on the other hand, belongs to the family Amaryllidaceae. In Hungary, numerous daffodil species and hybrids exist, with the two most common being the poet's narcissus (Narcissus poeticus L.) and the yellow daffodil (Narcissus pseudonarcissus L.). Both daylilies and daffodils are popular perennial ornamental plants, widely available in the horticultural trade in a range of hybrids and cultivars.

Key morphological differences include the following: the daylily is a rosette-forming plant with long, pointed, and recurved leaves. A distinct central midrib runs along each leaf, allowing it to fold like a book. In contrast, daffodil leaves emerge directly from the bulb, are narrow and straight, and end in a blunt tip. Their inflorescences also differ markedly, but since the plants had already flowered by the time of seizure, floral characteristics were not relevant for this case (Figure 3). A crucial morphological marker, however, was the root system: the daylily is rhizomatous, with cylindrical underground stems bearing adventitious roots, often with fibrous clusters[4]. The daffodil, by contrast — like tulips and hyacinths — is bulbous (Figure 4).

[3] 13/2001. (V. 9.) KöM rendelet: A védett és a fokozottan védett növény- és állatfajokról. [Decree No. 13/2001 (V. 9.) of the Ministry of Environment on protected and strictly protected species]. 1. számú melléklet

[4] Simon, T. – Seregélyes, T.: Növényismeret – A hazai növényvilág kis határozója [Plant Knowledge – A Field Guide to the Native Flora of Hungary]. Nemzeti Tankönyvkiadó. Budapest, 1998. 194

Figure 3
Daylily (1) and daffodil (2)
Source: https://florapont.hu (1) and www.sarahraven.com (2)

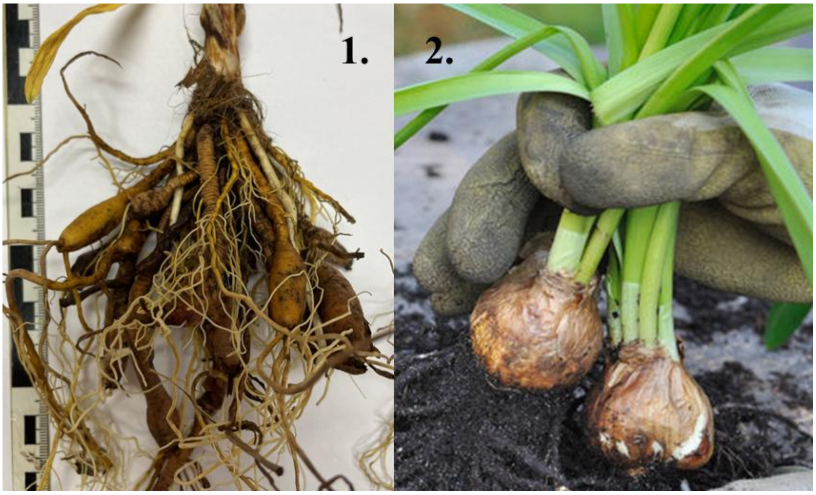

Figure 4
Roots of the daylily (1) and daffodil (2)
Source: HIFS (1) and gardenis.decorexpro.com (2)

Unlike daffodils, daylilies do not contain compounds harmful to humans and are therefore non-toxic. In fact, in some countries (e.g., China), their young leaves, shoots, and buds are consumed raw or cooked. Daffodils, by contrast, are toxic, containing the alkaloids lycorine and galantamine, found in both bulbs and leaves[5]. Ingesting daffodil leaves can be highly toxic and even fatal. The botanical examination confirmed that the leaves consumed by the kindergarten children belonged to the non-toxic daylily rather than the poisonous daffodil.

Suicide or Homicide?

The County Police Headquarters Operations Control Centre received a report that the body of a hanged man had been found on an unmarked trail, approximately 1 km from the village, suspended from a tree. The deceased was identified during the scene investigation. Based on preliminary findings, suicide was suspected, but the possibility of homicide could not be excluded. Unlike in routine procedures, the investigating authority decided not to submit the rope used for hanging to the Hungarian Institute for Forensic Sciences (HIFS). Instead, comparative samples of the tree bark and vegetation present on the trunk were collected for the forensic botanists. During the autopsy, swabs were taken from the palm and inner fingers of the deceased's left hand, while the right hand and the inner surfaces of the fingers were examined using micro-trace foil. These three samples were then submitted for forensic botanical analysis (Figure 5).

[5] Dános, B.: Farmakobotanika – A gyógynövénytan alapjai (kemotaxonómia) [Pharmacobotany – Fundamentals of Medicinal Plant Science (Chemotaxonomy)]. Argumentum. Budapest, 1997. 346. o.

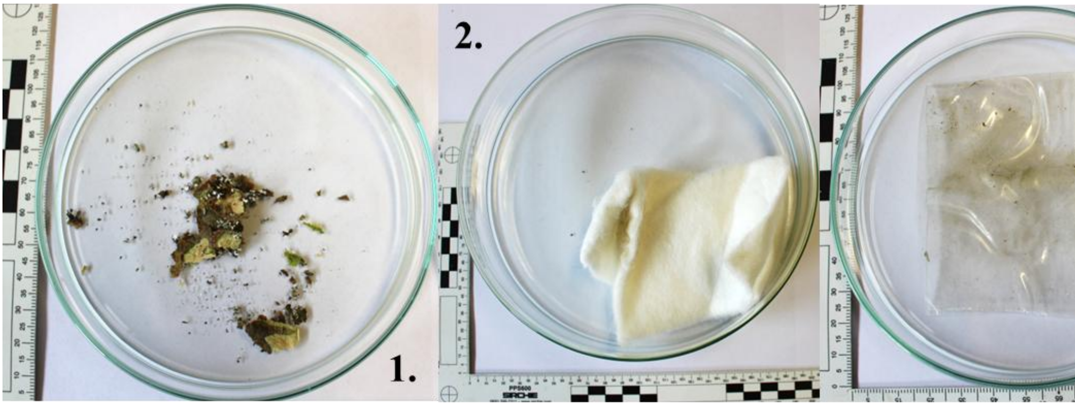

Figure 5
Comparative sample collected from the tree bark (1), as well as samples obtained from the left (2) and right hands (3)
Source: HIFS

The comparative sample from the tree bark contained several millimetre-sized bark fragments and numerous lichen thalli. Microscopic examination revealed that the bark fragments were too small for reliable identification, whereas the lichens were highly suitable for taxonomic characterisation (Figure 6).

Figure 6
Millimetre-sized bark fragment and lichen thallus
Source: HIFS

The lichen thalli exhibited the following traits: their upper (adaxial) surfaces were light grey to ash grey, while the lower (abaxial) surfaces were whitish or brownish. The thalli were non-venated, with a heteromerous (layered) structure, and the medulla lacked cavities. The lobes were simple, non-branching, and erect, bearing distinctive marginal cilia approximately 1 mm in length, white with darkened tips. Attachment to the substrate occurred via dull, dark-colored holdfasts. On the abaxial surface, rhizines were present, also white with blackened tips, extending as far as the margins. Certain lichen species are known to produce secondary metabolites that yield diagnostic colour reactions with specific reagents. In this case, applying potassium hydroxide (KOH) to the upper cortex produced a yellow reaction (KOH+)[6]. Based on the characteristics established during the examination, the lichen colonies obtained from the bark of the affected tree are colonies of the lichen species Physcia sp., which belongs to the family Physciaceae, among the foliose lichens.

The left-hand swab sample contained six small fragments of plant material ranging in colour from light to dark brown. Due to their size and condition, the wood fragments did not exhibit identifiable morphological features (Figure 7).

[6] Kecskés, M. – Naár, Z. – Padisák, J. – Tóth, S. – Babos, L.-né – Rimóczi, I. – Verseghy, K. – Orbán, S. – Simon, T. (ed.): Baktérium-, alga-, gomba-, zuzmó- és mohahatározó [Guide to Bacteria, Algae, Fungi, Lichens and Mosses]. Nemzeti Tankönyvkiadó. Budapest, 2001. 644, 691. o.

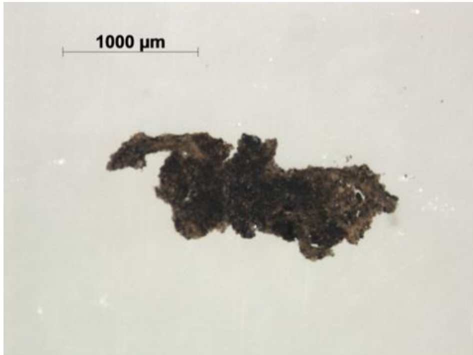

Figure 7
Swab from the left hand
Source: HIFS

The right-hand sample collected with micro-trace foil contained similar brown to greenish-brown wood fragments, along with ash-grey and greenish-grey lichen fragments, and white cilia with darkened tips matching those of the comparative Physcia thalli (Figure 8).

Figure 8
Sample obtained from the right hand secured with micro-trace foil
Source: HIFS

While the wood fragments could not be conclusively identified, the lichen material exhibited identical characteristics to those of the specimens collected from the tree bark. The forensic botanical analysis confirmed the investigating authority's assumption: the presence of identical lichen taxa in both the comparative bark samples and the right-hand traces supported the conclusion that the death had resulted from suicide rather than homicide (Figure 9).

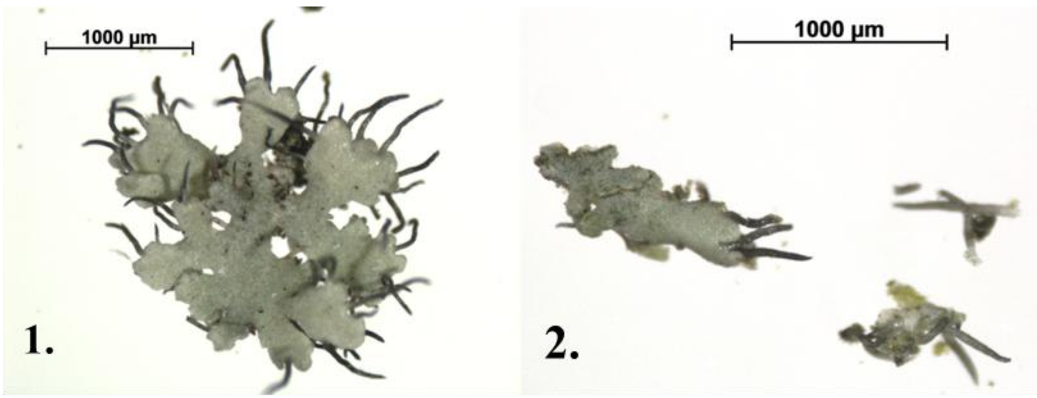

Figure 9
Lichen samples secured from the affected tree (1) and fixed from the right hand using micro-trace foil (2)
Source: HIFS

"Inside the house"

Based on a report, a criminal investigation was launched against an unidentified perpetrator for suspected theft. According to the complainant, the offence occurred between May 10 and 14, during which approximately 4 cubic meters of cut and prepared poplar wood were stolen from an agricultural plot located on the outskirts of the settlement. The estimated financial loss was approximately 100,000 HUF.

The investigating authority provided two wood samples for forensic botanical analysis, with the key question being whether the submitted specimens originated from poplar trees. Sample 1 consisted of a half-cut log measuring 268 × 156 mm, while Sample 2 was a log slice with a diameter of 230 mm and a thickness of 72–93 mm (Figure 10).

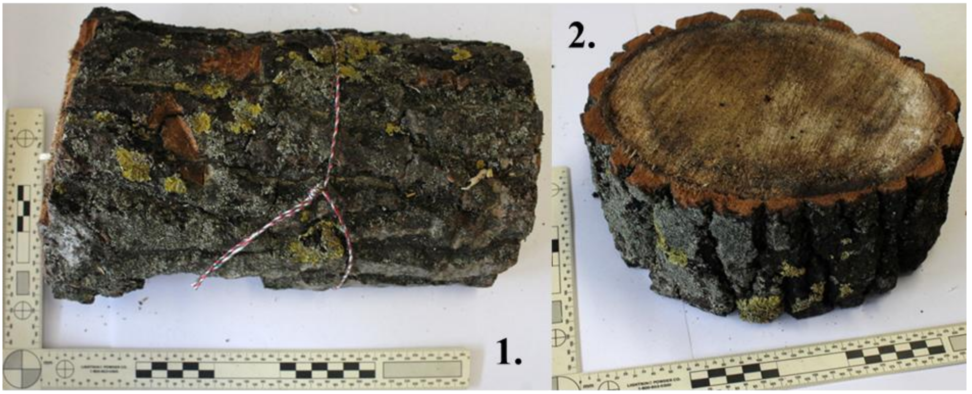

Figure 10
Wood sample 1 and wood sample 2
Source: HIFS

During the preparatory phase, subsamples were extracted from both logs for microscopic anatomical examination.

It was at this stage that lower plants (e.g., mosses, lichens) adhering to the bark were also noted, and samples of these were collected for identification and comparative purposes. Subsamples of the wood were sectioned in three planes — transverse, radial, and tangential — and sliced into micrometre-thin sections. These histological preparations, stained with toluidine blue, were mounted for microscopic examination. The use of three sectioning planes was necessary because the anatomical features of wood elements vary with orientation, and these differences provide critical diagnostic information for species identification.

Both wood samples exhibited identical microscopic anatomical features across all three planes. In transverse section, the wood was diffuse- to semi-ring-porous, with vessels occurring singly or in groups of two or three. Growth ring boundaries were only moderately distinct (Figure 11). The parenchyma was diffuse apotracheal, i.e., independent of the distribution of vessels. In radial section, the rays were homogeneous, with simple perforation plates between vessel elements, no tracheids, and recognisable libriform fibres (elongated, thick-walled, dead fibres with tapering ends) (Figure 12). In the tangential section, the rays were also homogeneous, with axially oval ray cells. Ray height was 9 - 11 cells in Sample 1 and 12 - 13 cells in Sample 2[7] (Figure 13).

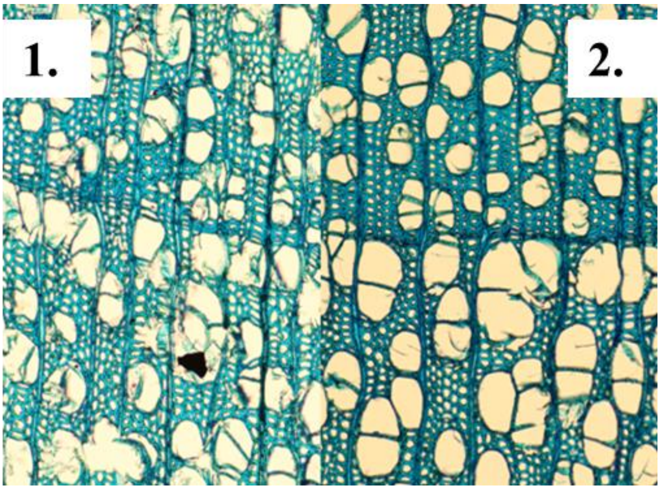

Figure 11
Cross-sections of wood samples 1 and 2
Source: HIFS

[7] Schoch, W. – Heller, I. – Schweingruber, F. H. – Kienast, F.: Wood anatomy of central European species. 2004.
Source: http://www.wsl.ch
Accessed: 11.04.2026

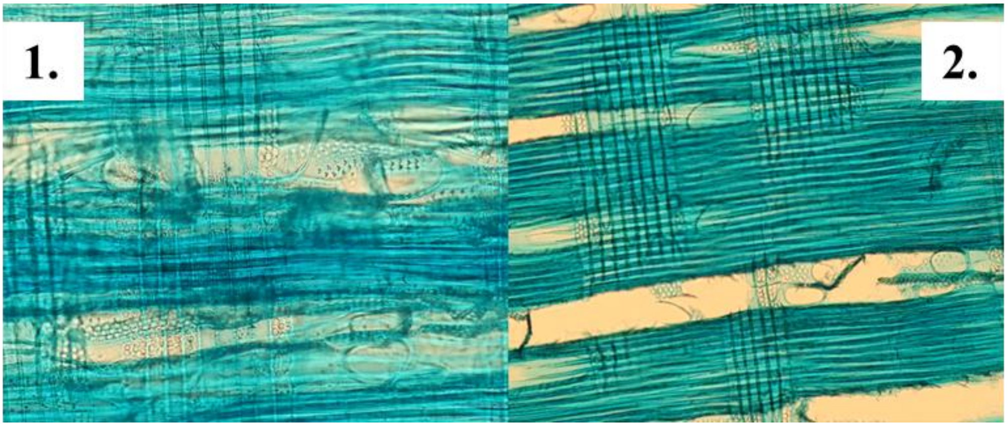

Figure 12
Radial longitudinal sections of wood samples 1 and 2
Source: HIFS

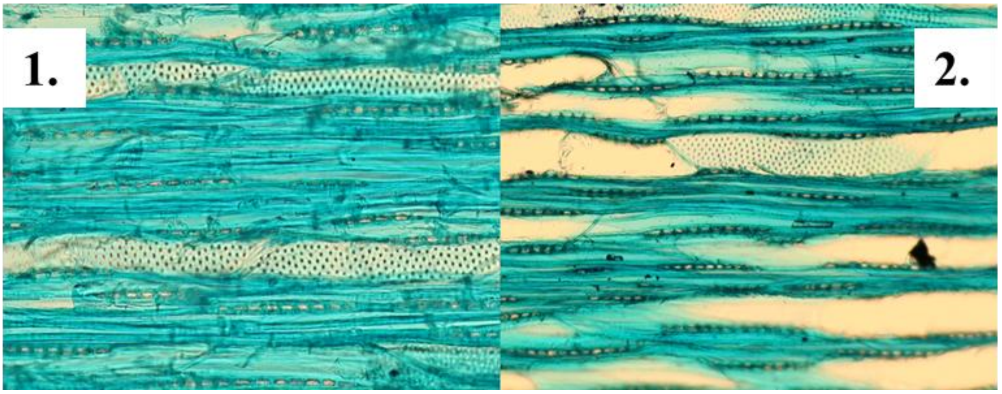

Figure 13
Tangential longitudinal sections of wood samples 1 and 2
Source: HIFS

Based on these micro-anatomical features, the samples were consistent with wood of poplar (Populus sp.) or birch (Betula sp.), two taxa with highly similar wood anatomy[8]. Thus, further botanical examinations were required. One supplementary method was to assess the bark's external

[8] Sárkány, S. – Szalai, I.: Növényszervezettani gyakorlatok [Plant Histology Practices]. Tankönyvkiadó. Budapest, 1966. 262–264. o.

characteristics, including colour and patterning. The characteristics of the bark - e.g., colour, pattern - were typical of the poplar tree (Populus sp.), which belongs to the willow family (Salicaceae).

At the HIFS, a new supplementary method was recently introduced, particularly in wood theft investigations, to support the results of anatomical analyses. When lower plants such as mosses or lichens are present on bark, their identification and comparison can provide additional evidentiary information. During sampling, lichen thalli were found on the bark of both wood specimens. At least two distinct lichen taxa were represented. One lichen species collected from the bark of Sample 1 exhibited yellow, orange, or yellow-green colouration on the upper surface and a white underside. The thallus lay flat on the substrate, with lobes that lifted at the margins and were broad, flat, or slightly concave. A distinctive feature was the abundance of apothecia (disk-shaped or cup-like fruiting bodies), with entire margins and soft, inflated discs. When tested with potassium hydroxide (KOH), the thallus yielded a deep red colour reaction (KOH+)[9]. These characteristics identified the species as the common orange lichen (Xanthoria parietina (L.) Th. Fr.), a foliose lichen of the family Teloschistaceae. This taxon is widespread on bark, calcareous rocks, and anthropogenic substrates, with habitats ranging from poplar groves and floodplain forests to cultivated lands and urban environments. A second lichen collected from the bark of Sample 1 had a grey, dull upper surface, a heteromerous structure, and a smooth, non-venated underside. The abaxial rhizines were dense, extending fully to the thallus margins. The thallus adhered loosely to the substrate. When treated with KOH, the upper cortex produced a yellow colour reaction (KOH+)[10]. Based on these properties, it is a colony of the lichen species Physcia sp., which belongs to the family

[9] Kecskés, M. – Naár, Z. – Padisák, J. – Tóth, S. – Babos Lórántné – Rimóczi, I. – Verseghy, K. – Orbán, S., szerk. Simon, T. (2001): i. m. 642, 688. o.

[10] Kecskés, M. – Naár, Z. – Padisák, J. – Tóth, S. – Babos Lórántné – Rimóczi, I. – Verseghy, K. – Orbán, S., szerk. Simon, T. (2001): i. m. 644, 691. o.

Physciaceae, among the foliose lichens. Physcia species occur on deciduous trees, e.g. poplar, ash, willow, etc., on calcareous or silicate rocks (Figure 14).

Microscopic examination confirmed that both Xanthoria parietina L. and Physcia sp. were also present on the bark of Sample 2 (Figure 15). The combined anatomical and morphological evidence, supported by the newly introduced lichen-based supplementary analysis, confirmed that the seized wood samples originated from poplar (Populus sp.).

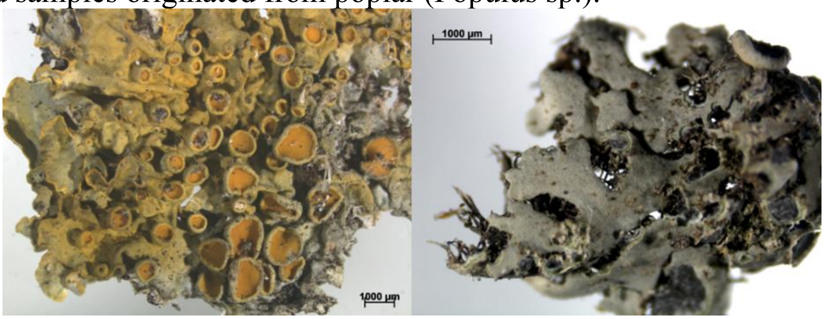

Figure 14
Xanthoria parietina L. and Physcia sp. secured from wood sample 1
Source: HIFS

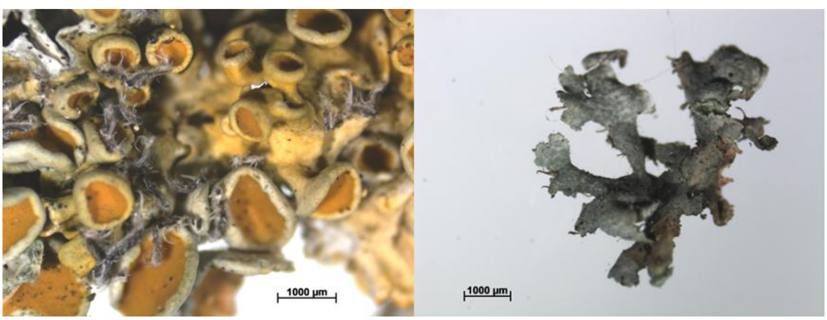

Figure 15
Xanthoria parietina L. and Physcia sp. secured from wood sample 2
Source: HIFS

What did you eat last?

An administrative investigation was initiated following the death of an individual at home. The on-call physician at the scene excluded both suicide and homicide. However, during the autopsy, plant material was found in the stomach contents of the deceased, raising suspicion of yew (Taxus sp.) poisoning. At the forensic medical expert's request, the material was submitted for botanical analysis. The stomach contents were delivered in a sealed plastic container and consisted of mucous material intermixed with brownish needle leaves and needle fragments (Figure 16). As a first step, the plant material was washed twice to remove the mucus. The cleaned remains were then sorted to recover as many intact or partially preserved needles as possible for microscopic identification. The external morphology of the needles was as follows: they were elongate and flattened, with a pointed apex and a narrowed basal portion forming a petiole-like clasp around the twig. A single midrib ran through the centre, with stomata arranged in two rows along the abaxial surface. The colour was brown, most likely due to chemical interaction with gastric fluids (Figures 17 and 18).

Figure 16
Container holding the stomach contents of the deceased
Source: HIFS

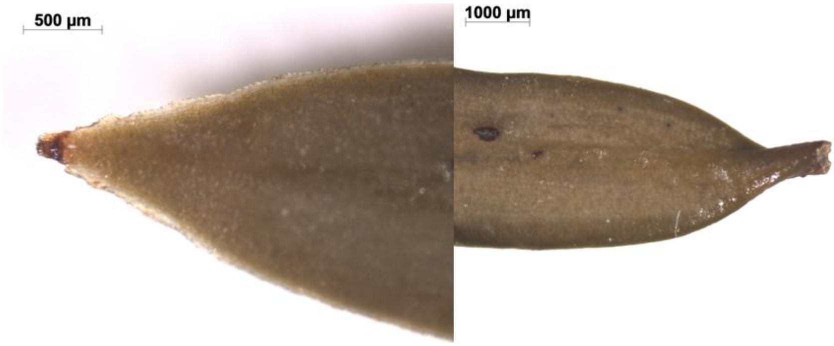

Figure 17
Coniferous needles were found in the stomach contents
Source: HIFS

Figure 18
Coniferous needle found in the stomach contents and comparative sample collected from the garden
Source: HIFS

To achieve higher accuracy, a histological analysis was performed in addition to external morphological assessment. A transverse section was prepared from an intact needle, stained with basic toluidine blue, and mounted for microscopic examination. The micro-anatomical features included: an epidermis composed of thick-walled cells; a central vascular bundle consisting of xylem and phloem; transfusion tissue flanking the vascular bundle on both sides; and a heterogeneous mesophyll dominated by spongy parenchyma (Figure 19). Importantly, the needle lacked resin canals[11].

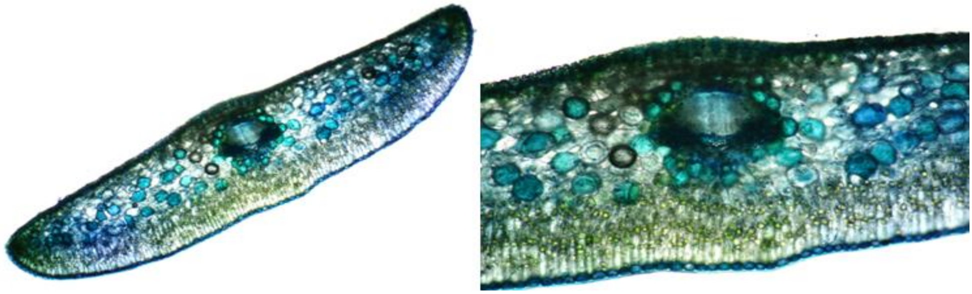

Figure 19
Histological image of the coniferous needle found in the stomach contents
Source: Kovács, J. S. (n.d.): Histological image of coniferous needle. Personal contribution.

These external and microscopic features were consistent with the family Taxaceae, genus Taxus, specifically the common yew (Taxus baccata L.). The yew is a slow-growing, native Hungarian species widely planted as an ornamental tree. Its most distinctive feature is the bright red, fleshy, berry-like aril surrounding the seed. The seed itself is hard, covered by protective scales, and matures within the aril after pollination[12]. While the fleshy aril is non-toxic and sometimes even consumed, all other parts of the plant (needles, bark, seeds) are highly poisonous. The toxic compounds are diterpenoid alkaloids (e.g., taxine, taxicine) and cyanogenic glycosides[13]. The botanical examination confirmed the suspicion of yew poisoning and suicide.

[11] Hamidipour, A. – Radjabian, T. – Charlet, D. A. – Zarrei, M. (2011): Leaf anatomical investigation of Cupressaceae and Taxaceae in Iran. Wulfenia, 18. 95–111. o.
[12] Coombes, A. J.: Határozó kézikönyvek: Fák [Identification manuals: Trees]. Taramix Kft. 2009. 79. o.
[13] Dános, B.: Farmakobotanika – gyógynövényismeret [Pharmacobotany – medicinal plant knowledge]. Semmelweis Kiadó. Budapest, 2006. 29. o.

Summary

Forensic botany, as a special branch of forensic activities, can contribute significantly to forensic investigations. The study aims to demonstrate the role and evidentiary power of plant evidence - such as needles, lichens and plant specimens - in investigative work through the examples of several domestic cases. The botanical methods used during the examinations, such as external morphological characteristics and histological examination, enable the precise identification of the samples. The cases described in the study (e.g. suspicion of poisoning, wood theft, exclusion of suicide) highlight that the examination of plant evidence not only enables a more accurate reconstruction of the facts but also effectively complements the work of other forensic disciplines (e.g. medical experts, toxicologists).