USE OF MEDICINAL PLANTS AS A PART OF CULTURAL INTERPRETATION AND ENVIRONMENTAL EDUCATION

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Abstract

The paper focuses on the possibilities of using medicinal, aromatic and spice plants (MAPs) in environmental education and in the interpretation of cultural and natural heritage within recreational and tourism activities.

Based on the study of selected historical herbaria, the identification and quantification of recorded plant species are carried out. The findings are further applied in the development of a methodology for establishing exhibition plantings of MAPs inspired by historical sources, which can serve as components of educational gardens, botanical displays or interpretive trails.

The research also includes an analysis of methods for preparing durable plant exhibits for exhibition and educational purposes, for example through freeze-drying and other preparation techniques. These exhibits represent a sustainable alternative to living plants, as they enable long-term presentation of plant material without the limitations of seasonality and high maintenance requirements.

The result is a set of practical approaches and recommendations that link the study of historical sources with modern forms of plant presentation and contribute to the development of environmental education, the interpretation of cultural landscapes, and the sustainable recreational use of natural and cultural heritage.

Key words: herbarium, plant preservation, exhibition planting, education, garden tourism

Introduction

Medicinal plants represent an important link between cultural heritage and environmental education, as they enable the interpretation of historical knowledge while simultaneously supporting contemporary approaches to their conservation and presentation.

The origins of herbaria date back to the 16th century, when the spread of paper following the invention of the printing press enabled the effective drying and preservation of plants. The first herbaria were created around 1540, most likely in Italy, and rapidly spread across Europe, where they became a key tool for botanical research and systematics (Thijsse, 2025). An important role was played by the order of the Brothers Hospitallers, within which herbaria served both practical and educational purposes. Notable examples include the herbaria of Joachim Ramschissl, Norbert Boccius (1766), and Menander Fekete (1841) (Surá et al., 2023). The Broumov Herbarium from 1595 represents the oldest known herbarium in the territory of the Czech Republic and constitutes a valuable source for understanding the history of botany in Central Europe (Skružná et al., 2024). At present, emphasis has shifted towards the conservation, research, and accessibility of herbarium collections, reflected in methodological approaches to the care of *hortus siccus* collections (Novák et al., 2025).

Drying is one of the oldest methods of plant preservation, enabling long-term stability of material, although this results in the loss of spatial structure. The effects of various drying agents on the quality of plant material, including colour and inflorescence shape, have been described, for example, in *Bellis perennis* and *Malva sylvestris* (Jezdinský et al., 2024, 2025). Other methods include glycerine preservation, which maintains tissue flexibility (White et al., 2007), and encapsulation in epoxy resin, which allows long-term preservation of shape and structure (Pratheeksha & Tanuja, 2024). Additional

approaches include liquid preservation, staining, and freeze-drying (lyophilisation), which, according to Antal et al. (2011), preserves aromatic compounds more effectively than hot-air drying, although optimal conditions for plant materials cannot be universally defined (Chen et al., 2000).
An alternative to these methods is the preservation of plants *in situ* through exhibition plantings, which allow the presentation of living plants in their natural context and fulfil an important educational function (Smékalová et al., 2025). These plantings also enable direct interaction between visitors and plants, supporting a better understanding of their biological characteristics and historical uses.
The aim of this paper is to present the outputs of the project "History of the Use and Cultivation of Medicinal Plants as Part of National and Cultural Identity", which focuses on the analysis of historical sources, the development of the use of medicinal, aromatic, and spice plants, and the creation of tools for their presentation. The study is conceived as an integrated approach combining historical analysis of herbarium collections, the establishment of exhibition plantings, and experimental verification of plant preservation methods.

Material and methods
The research was designed as a combination of historical-analytical study, field implementation, and experimental work, forming three interrelated pillars.
Within the first pillar, a floristic revision of selected herbarium specimens from the digitised historical herbarium of Norbert Boccius (1766) was carried out. Individual specimens were taxonomically identified and the representation of species was quantified. The following sources were used for identification: Key to the Flora of the Czech Republic, Flora of the Czech Republic (Vols. 1–8), the Pladias database, Plants of the World Online (POWO), and the Global Biodiversity Information Facility (GBIF). The obtained data served as a basis for further applications in the interpretation of historical sources.
The second pillar focused on the design and implementation of an exhibition planting of useful plants in the grounds of Kačina Castle. The planting design was based on historical sources and the results of the floristic analysis of the Boccius and Broumov herbaria. Species requirements, as well as aesthetic and educational aspects, were considered during planning. The implementation included site preparation and planting of selected species.
The third pillar consisted of experimental verification of freeze-drying methods for flowers intended for exhibition and educational purposes. Due to the problematic structure of flowers (high water content and low tissue permeability), a modified approach was applied in addition to the standard procedure. Freeze-drying was performed using a Lyotrade Amaru device. Flowers were immediately frozen after collection at −75 °C, subsequently tempered in a pre-cooled freeze-dryer (−35 °C, 50 kPa, 8 h), and then dried at a pressure of 40 Pa and a shelf temperature of 35 °C for 36 h. In the modified procedure, flowers were immersed in deionised water (7 °C) prior to freezing, fixed to prevent floating, and after 24 h of freezing (−75 °C) freeze-dried under identical conditions.

Results
1) Survey of selected herbarium specimens
The Boccius herbarium was found to contain a total of 1,136 specimens across three volumes, of which 885 have been reliably identified to date. The ten most represented plant families account for approximately 60% of all identified species. The family Asteraceae predominates, followed by Lamiaceae, Fabaceae, and Apiaceae among native species and archaeophytes. In contrast, Poaceae—one of the most species-rich families in the Czech flora—is only the sixth most represented in the Boccius herbarium.
Comparison with the Czech Pharmacopoeia (2023) revealed 74 unique species corresponding to 98 herbarium records, representing approximately 8% of the total number of specimens.
2) Establishment of an exhibition planting
An exhibition bed measuring 24.5 × 2 m was established in the grounds of Kačina Castle, situated in front of the former carriage house. The planting was based on historically documented medicinal and useful plants recorded in both the Boccius and Broumov herbaria and includes approximately 40 species, predominantly perennials.
The first phase (14 October 2025) involved the planting of perennial species, with annuals to be added in spring 2026. The species composition includes, for example, *Achillea pannonica*, *Antennaria dioica*, *Anthemis tinctoria*, *Aquilegia vulgaris*, *Foeniculum vulgare*, *Fragaria vesca*, *Hypericum perforatum*, *Malva sylvestris*, *Nepeta cataria*, *Salvia pratensis*, *Thymus pulegioides*, and *Veronica spicata*.
The planting forms a coherent functional and visual unit corresponding to the intended historical-educational concept and will serve as an outdoor component of the exhibition *"Gardens Bound in Books"* at Kačina Castle in 2026.

3) Optimisation of freeze-drying methods
Under standard freeze-drying conditions, significant deformation or “inflation” of petals was observed across all analysed samples (*Ficaria verna*, *Viola odorata*, *Bellis perennis*, *Geranium sanguineum*).
In contrast, the method involving freezing in an ice matrix resulted in markedly better preservation of both shape and colour.

Discussion
The species composition of the Boccius herbarium indicates a dominance of families such as Asteraceae, Lamiaceae, and Apiaceae, differing from their representation in the flora of the Czech Republic (Slavík, 1997; 2000; Slavík & Štěpánková, 2004). This can be explained by the higher proportion of medicinal and otherwise useful species within these groups. Conversely, the lower representation of Poaceae is likely related to its more limited practical use. The relatively low overlap with the Czech Pharmacopoeia (2023) reflects differences between historical and contemporary concepts of medicinal plants.
Further findings demonstrate the potential of historical herbarium data as a basis for the design of educational plantings that connect cultural heritage with environmental education and landscape interpretation. The Kačina planting exemplifies the practical translation of such historical botanical data into a contemporary interpretive context. Species selection considered not only historical relevance but also ecological adaptability and functionality in public spaces. The resulting concept therefore represents not merely a reconstruction, but a purposeful interpretation adapted to current educational and presentation needs.
The observed deformation of petals during freeze-drying can be attributed to tissue expansion caused by water vapour accumulation combined with structural collapse when critical temperature thresholds are exceeded. Imbalances between heat input and sublimation rate likely resulted in increased internal pressure and tissue expansion. Simultaneously, local exceeding of the glass transition temperature (Tg) may have reduced viscosity and mechanical stability (Karathanos et al., 1996). Freezing in an ice matrix mitigated overheating and enabled more uniform vapour removal, resulting in improved preservation of both morphology and colour.

Conclusion
The study of the Boccius herbarium revealed differences between historical and contemporary concepts of medicinal plants. These findings were successfully applied in the design of an exhibition planting representing a practical interpretation of historical sources within a modern educational context. Furthermore, optimisation of freeze-drying methods demonstrated the potential to produce higher-quality plant specimens with preserved structure, suitable for long-term use in environmental education and the presentation of cultural and natural heritage. This integrated approach—combining historical research, practical implementation, and innovative preservation techniques—represents a valuable model for the application of botanical knowledge.

References
Antal, T., Figiel, A., Kerekes, B., Sikolya, L. (2011). Effect of drying methods on the quality of the essential oil of spearmint leaves (Mentha spicata L.). Drying Technology, 29(15), pp. 1836–1844.
Český lékopis (2023). Český lékopis 2023: Pharmacopoea Bohemica MMXXIII (Ph. B. MMXXIII). 4. díl, Národní část. Praha: Grada Publishing. ISBN 978-80-271-5059-5.
Chen, W., Gast, K. L., Smithey, S. (2000). The effects of different freeze-drying processes on the moisture content, color, and physical strength of roses and carnations. Scientia Horticulturae, 84(3–4), pp. 321–332.
Jezdinský, A., Jezdinská Slezák, K. A., Neugebauerová, J., Híc, P., Štorková, T., Smékalová, K. (2024). Účinnost různých desikantů a sušicích látek při sušení sedmikrásky. Zahradnictví = Záhradníctvo, 23(7), pp. 39–43.
Jezdinský, A., Neugebauerová, J., Híc, P., Štorková, T., Kopta, T., Jezdinská Slezák, K. A. (2025). Sušení květů slézu (Malva sylvestris var. mauritiana) pro tvorbu trvalých exponátů. Zahradnictví = Záhradníctvo, 24(6), pp. 76–81.
Karathanos, V. T., Anglea, S. A., Karel, M. (1996). Structural collapse of plant materials during freeze-drying. Journal of Thermal Analysis and Calorimetry, 47(5), pp. 1451–1461.
Novák, Z., Sobotková, J., Skružná, J., Kubásková, L., Strnadová, L., Slovik, R. (2025). Metodika péče o historické herbáře typu hortus siccus. Praha: Národní zemědělské muzeum.
Pratheeksha, C. T., Tanuja, R. N. (2024). Epoxy resin encapsulation: A novel approach for preserving dry flowers and ornamentals. Current Agriculture Trends, 3(5), pp. 8–11.

Skružná, J., Pokorná, A., Dobalová, S., Strnadová, L. (2024). Nejstarší herbář sušených rostlin na území České republiky (1595). Dějiny věd a techniky, 57(1–2), pp. 70–98.
Slavík, B. (ed.) (1997). Květena České republiky, díl 5. Praha: Academia.
Slavík, B. (ed.) (2000). Květena České republiky, díl 6. Praha: Academia.
Slavík, B., Štěpánková, J. (eds.) (2004). Květena České republiky, díl 7. Praha: Academia.
Surá, D., Štorková, T., Neugebauerová, J., Jezdinský, A. (2023). Herbářové sbírky milosrdných bratří českomoravské provincie. Prameny & Studie, 74.
Thijsse, G. (2025). Everlasting Gardens: Origin, Purpose, Spread and Use of the First Herbaria. In: The Green Middle Ages. London: Routledge, pp. 72–108.
White, P., Tija, B., Sheehan, M. R., Brown, S. P. (2007). Drying and preserving plant materials. Available at: www.edis.ifas.ufl.edu/ep00400.pdf

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Souhrn
Tato studie představuje integrovaný přístup k využití léčivých, aromatických a kořenících rostlin v environmentální výchově a zprostředkování kulturního dědictví. Analýza historického herbáře Norberta Bocciuse odhalila rozdíly mezi historickým a současným pojetím léčivých rostlin, které byly následně uplatněny při návrhu výstavní výsadby. Současně se ukázalo, že upravené metody lyofilizace zlepšují zachování struktury rostlin. Výsledky potvrzují přínos propojení historického výzkumu, praktické realizace a inovativních technik prezentace rostlin.

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