PROTECTION OF BIOLOGICAL DIVERSITY OF MEDICINAL PLANTS

PROTECȚIA DIVERSITĂȚII BIOLOGICE A PLANTELOR MEDICINALE

FERȚU Ionela Daniela[2]*, TUDOR Mihai[1], TOPOR Gabi[2]

*Corresponding author e-mail: danafertu2004@yahoo.com

Abstract.
Protecting the biological diversity of medicinal plants is essential for preserving ecosystem health and human well-being. This paper explores the significance of medicinal plants in traditional and modern medicine, highlighting their contribution to the provision of therapeutic resources. The study identifies the main threats to the biodiversity of these species, including unsustainable harvesting, habitat development, and the impact of climate change. Conservation proposals discussed include in situ protection through the creation of natural protected areas and ex-situ conservation through the establishment of seed banks and botanical gardens. It also emphasizes the importance of community education and the involvement of local people in conservation efforts. Collaboration between researchers, policymakers, and communities is essential to save medicinal plant biodiversity and ensure sustainability.
Keyword: biodiversity, medicinal plants, sustainability

Rezumat.
Protejarea diversității biologice a plantelor medicinale este esențială pentru păstrarea sănătății ecosistemelor și a bunăstării umane. Această lucrare explorează semnificația plantelor medicinale în medicina tradițională și modernă, subliniind contribuția lor la furnizarea de resurse terapeutice. Studiul identifică principalele amenințări la adresa biodiversității acestor specii, inclusiv recoltarea nesustenabilă, dezvoltarea habitatelor și impactul schimbărilor climatice. Propunerile de conservare discutate includ protecția in situ prin crearea de arii naturale protejate și conservarea ex situ prin înființarea băncilor de semințe și grădini botanice. De asemenea, se pune accent pe importanța educației comunității și implicarea localnicilor în eforturile de conservare. Colaborarea între cercetători, factori de decizie și comunități este esențială pentru salvarea diversității biologice a plantelor medicinale și asigurarea sustenabilului.
Cuvinte cheie: biodiversitate, plante medicinale, sustenabilitate

[1] Bujoru Viticulture and Winemaking Research - Development Station
[2] "Dunărea De Jos" University Galati, Faculty of Medicine and Pharmacy, Department Of Pharmaceutical Sciences

INTRODUCTION

The protection of biological diversity of medicinal plants has become a priority of global interest, which requires integrative and collaborative strategies. This paper examines the importance of conserving medicinal plant biodiversity to identify the threats they face and effectively address them for conservation.

About 40% of plant species face extinction in the coming decades [Anmol *et al.*, 2024]. Various traditional medicinal systems around the world have documented a wide range of plants, highlighting the profound therapeutic significance of medicinal plants [Atanasov *et al.*, 2015]

Deepening the link between human health, biodiversity, and sustainability leads to a deeper understanding of botanical resources and the need to protect them.

To avoid wasting resources on ineffective interventions, there is an urgent need to understand which conservation actions will have positive outcomes for endangered species [Binley *et al.*, 2025]

Medicinal plant diversity is one of the key components of plant diversity, and medicinal plants are one of the material bases of our current medical and food supplies [Davis and Choisy, 2024].

The biological diversity of medicinal plants is a valuable fundamental resource for human health and ecosystem balance. Over time, these plants have been used in various therapeutic traditions and continue to have a significant impact on contemporary medicine. Thanks to their bioactive compounds, medicinal plants offer solutions for a variety of conditions, from chronic diseases to acute disorders, being indispensable resources in the search for natural and effective treatments.

MATERIAL AND METHOD

For this study, scientific databases were searched to identify sources of relevant information. Databases were used as sources of information: ScienceDirect, Springer, Wiley, PubMed, Scopus, and Web of Science databases were searched.

These databases cover the period 2010-2024 because we have studied the most recent studies to carry out an objective and up-to-date review of the topic addressed.

The search strategy was designed to be comprehensive and specific, aiming to capture all relevant studies related to the biological diversity of medicinal plants.

The study selection process was carried out in several stages to include only high-quality studies.

Initially, all identified studies were screened based on their titles and abstracts to determine their relevance to the chosen research topic. In the next step, the remaining studies underwent a comprehensive review to assess their eligibility for inclusion in the systematic review. Studies that met predefined inclusion criteria were selected for further analysis.

The selected studies were then included in the systematic review, where their findings and methodologies were critically appraised and synthesized.

The careful research carried out in this study aimed to identify all relevant studies on the protection of medicinal plant biodiversity and the complex relationship between factors that positively or negatively influence this aspect.

RESULTS AND DISCUSSIONS

Medicinal plants have been used for centuries across cultures for treatment. Over 50,000 plant species are considered medicinal, with around 4,000 used in pharmaceutical products. Studies show that 80% of the global population relies on medicinal plants, especially in rural and developing areas with limited access to modern medicine. However, these plants face constant threats, including over-exploitation, unsustainable harvesting, pollution, climate change, and reduced interest in their cultivation and conservation.

Increasing numbers of different concurrent multifactorial stressors cause a severe decrease in plant growth and survival, as well as the biodiversity of the microbiome on which plants depend [De Chandra, 2016].

Various factors such as environment (rainfall, lack of pollinators, clogging of water bodies), development activities (deforestation, infrastructure, submergence), agriculture and forestry methods (monoculture, overexploitation, invasions) have led to the disappearance of these traditionally important medicinal plants [Huang et al, 2019]. Overharvesting is one of the biggest threats to species' survival [Hossain, 2016]. The conservation and protection of medicinal plants is particularly important as at least two-thirds of medicinal plants continue to be harvested from the wild [Liu et al., 2019]. Excessive collection based on medicinal and economic value has the potential to damage regional ecosystem stability [Davis and Choisy, 2024]. Ensuring the controlled collection of medicinal plants through sustainable policy instruments plays an important role in areas where traditional medicine is predominantly used [McNeil et al, 2023].

Many medicinal plants are intensively harvested from their natural habitat for industrial, medicinal, or commercial use. This leads to the decline of populations and, in some cases, the complete disappearance of the specific. For example, ginseng (*Panax ginseng*) and echinacea root (*Echinacea purpurea*) are often under pressure to survive due to high market demand.

Panax ginseng is highly valued in traditional Asian medicine and is often used for its adaptogenic properties, which help increase the body's resistance to stress [Nazari, 2023]. Its popularity has grown not only in Asia but also in international markets, leading to intensive harvesting. This, along with the plant's long growth time, which can take 6-10 years for an optimal harvestable size, means that natural resources are quickly depleted.

Echinacea purpurea often faces significant pressures on survival due to high market demand. This plant is particularly valued for its properties as an immunostimulant, being widely used in traditional medicine and the food supplement industry [Posadzki et al, 2013].

This herb has been used for centuries by Indigenous communities in North America and is recognized as a natural remedy for a variety of ailments, including respiratory infections, colds, and inflammation [Sun et al, 2022]

Unfortunately, the high demand has led to the intensive harvesting of echinacea from its natural habitat. Currently, *Echinacea* is popular in the world and

is found in different forms. The United States has implemented regulations to limit the harvesting of echinacea during certain growing seasons to allow the plants to regenerate. A case study conducted in North Carolina analyzed the effects of implementing *Echinacea* harvest restrictions in the context of increasing market demands and pressures on wild populations. This study, conducted by Huang et al., 2020, revealed essential aspects of medicinal plant conservation and natural resource management strategies [Tan et al., 2018]

Hossain, 2016, conducted a study to assess the impact of overharvesting *Panax ginseng* in North Carolina forests. This research included a detailed analysis of plant density in different areas, comparing regions with intensive harvesting activity to those benefiting from protection or harvesting restrictions, and found that uncontrolled harvesting causes significant declines in plant numbers, affecting their long-term viability [Zandalinas et al, 2021]

In addition to the abusive harvesting of plants with therapeutic potential, an important factor influencing their biodiversity is the threats related to the irrational use of all polluting substances. The intensive use of pesticides and fertilizers in agriculture, along with industrial emissions, generates chemical pollution. These substances can enter the soil and water, affecting medicinal plant plantations.

Some pesticides can inhibit root growth or reduce the plant's ability to absorb nutrients, which can lead to poor growth or even plant death. Plants have to cope with the attacks of various pests and pathogens of the environmental conditions increase the vulnerability of plants to the attack or different ways of attack by insects [De Chandra, 2016], [McNeil et al., 2023]. Declines in the density of crucial pollinator species such as bees, butterflies, beetles, and other insects have also resulted in drastic negative effects on medicinal plant biodiversity.

Pollinators, especially bees, feed on the nectar of medicinal plants, while other animals consume their leaves or seeds. Thus, medicinal plants play a dual role – they support both local biodiversity and ecosystem health.

Lavandula officinalis, Mentha piperita, or *Hypericum perforatum* are just some of the plants used for medicinal purposes, whose reproduction and development are directly influenced by pollination [Zhang et al, 2017].

The decline of pollinators, especially in polluted areas, directly affects the survivability of these medicinal plants, threatening both ecological balance and access to medicinally important resources. Many medicinal plants are not only therapeutic resources for humans, but also food for insects, birds, and small mammals.

Drought and salinity stress pose significant threats to sustainability and biodiversity, jeopardizing essential medicinal resources for both traditional healing and the pharmaceutical sector [Zhang et al., 2020].

Another factor influencing the biodiversity of medicinal plants is genetic diversity. This is essential for the adaptation and survival of medicinal plants to environmental changes, diseases, and other stressors.

Studies on medicinal plants have also focused on breeding high-yielding cultivars with adaptability to environmental stress conditions [Zhang et al. 2020].

The decrease in genetic diversity of medicinal plants caused by climate change, pollution, habitat reduction, or pollinator decline has ecosystem consequences.

It is important that genomic sequencing be used to select new improved medicinal plant varieties or to help transform this knowledge into "living factories" of bioactive compounds [Anmol et al. 2024].

A plant population with low genetic diversity loses its ability to adapt effectively to environmental factors in the absence of robust genetic diversity, medicinal plants become more susceptible to these changes, which may threaten their survival.

CONCLUSIONS

Recent studies on the overharvest of medicinal plants highlight its negative impact on biodiversity and the need for effective conservation. Genetic variability is crucial for the survival of these plants, allowing them to adapt to climate change, pests, and other stressors. High genetic diversity ensures stronger plants and a wider range of chemical compounds, vital for discovering new treatments. Loss of this diversity weakens reproductive capacities and threatens species survival. Ongoing research, sustainable management strategies, and community education are essential for preserving medicinal plants, with collaboration between researchers, authorities, and locals being key to their protection.

REFERENCES

1. **Anmol, G. Aggarwal, M. Sharma, R. Singh, Shivani, and U. Sharma, 2024** - *Ethnopharmacologically important highly subsidized Indian medicinal plants: Systematic review on their traditional uses, phytochemistry, pharmacology, quality control, conservation status and future prospective*, J Ethnopharmacol, vol. 320, p. 117385, doi: 10.1016/j.jep.2023.117385.
2. **Atanasov A. G., Waltenberger Birgit, Pferschy-Wenzig Eva-Maria, Linder Thomas, Wawrosch Christoph, Uhrin Pavel, Temml Veronika, Wang Limei, Schwaiger Stefan, Heiss Elke H., Rollinger Judith M., Schuster, Daniela Breuss, Johannes M., Bochkov Valery, Mihovilovic Marko D., Kopp Brigitte, Bauer Rudolf, Dirsch Verena M., Stuppner Hermann, 2015** - *Discovery and resupply of pharmacologically active plant-derived natural products: A review*, Biotechnol Adv, vol. 33, no. 8, pp. 1582–1614, doi: 10.1016/j.biotechadv.2015.08.001.
3. **Binley A. D., Haddaway L., Buxton R., Lalla KM, Lesbarreres D., Smith P. A, Bennett J. R., 2025 -** *Endangered species lack research on the outcomes of conservation action*, Conserv Sci Pract, Jan., doi: 10.1111/csp2.13304.
4. **Davis C. C. and Choisy P., 2024 -** *Medicinal plants meet modern biodiversity science*, Current Biology, vol. 34, no. 4, pp. R158–R173, Feb., doi: 10.1016/j.cub.2023.12.038.
5. **Chandra De L.,** 2016 - *Bio-Diversity and Conservation of Medicinal and Aromatic Plants*, Advances in Plants & Agriculture Research, vol. 5, no. 4, Dec. 2016, doi: 10.15406/apar.2016.05.00186.

6. **Huang Guorui, Hoekstra Arjen Y., Krol Maarten S., Jagermeyr Jonas, Galindo Alejandro, Yu Chaoqing, Wang Ranran, 2020 -** *Water-saving agriculture can deliver deep water cuts for China*, Resour Conserv Recycl, vol. 154, p. 104578, doi: 10.1016/j.resconrec.2019.104578.
7. **Hossain M., 2016 -** *Grassroots innovation: A systematic review of two decades of research*, J Clean Prod, vol. 137, pp. 973–981, doi: 10.1016/j.jclepro.2016.07.140.
8. **Liu H., Gale S. W, Cheuk M. L. Fischer G. A.,2019 -** *Conservation impacts of commercial cultivation of endangered and overharvested plants*, Conservation Biology, vol. 33, no. 2, pp. 288–299, doi: 10.1111/cobi.13216.
9. **McNeil B. K., Renaud D. L., Steele M. A., Keunen A. J., and DeVries T. J.**, **2023** - *Effects of Echinacea purpurea supplementation on markers of immunity, health, intake, and growth of dairy calves*, J Dairy Sci, vol. 106, no. 7, pp. 4949–4965, doi: 10.3168/jds.2022-22862.
10. **Nazari M., Ghasemi-Soloklui A. A., Kordrostami M., and Abdel Latef A. A. H.**, **2023** - *Deciphering the response of medicinal plants to abiotic stressors: A focus on drought and salinity*, Plant Stress, vol. 10, p. 100255, doi: 10.1016/j.stress.2023.100255.
11. **Posadzki P., Watson L. K., Ernst E., 2013 -** *Adverse effects of herbal medicines: an overview of systematic reviews*, Clinical Medicine, vol. 13, no. 1, pp. 7–12, doi: 10.7861/clinmedicine.13-1-7.
12. **Sun Mingyang, Xu Shiqiang, Mei Yu, Li Jingyu, Gu Yan, Zhang Wenting, Wang Jihua, 2022 -** *MicroRNAs in Medicinal Plants*, Int J Mol Sci, vol. 23, no. 18, p. 10477, doi: 10.3390/ijms231810477.
13. **Tan B. L., Norhaizan M. E., Liew W.-P.-P., and Sulaiman Rahman H.**, **2018** - *Antioxidant and Oxidative Stress: A Mutual Interplay in Age-Related Diseases*, Front Pharmacol, vol. 9, doi: 10.3389/fphar.2018.01162.
14. **Zandalinas S. I., Fritschi F. B., and Mittler R.**, **2021** - *Global Warming, Climate Change, and Environmental Pollution: Recipe for a Multifactorial Stress Combination Disaster*, Trends Plant Sci, vol. 26, no. 6, pp. 588–599, doi: 10.1016/j.tplants.2021.02.011.
15. **Zhang H. and Sonnewald U.**, **2017** - *Differences and commonalities of plant responses to single and combined stresses*, The Plant Journal, vol. 90, no. 5, pp. 839–855, doi: 10.1111/tpj.13557.
16. **Zhang Ming-Xu, Chen Yuan, Guo Jing-Xia, Zhang Ru, Bi Ya-Qiong, Wei Xin-Xin, Niu Hui, Zhang Chun-Hong, Li Min-Hui, 2022 -** *Complex ecological and socioeconomic impacts on medicinal plant diversity*, Front Pharmacol, vol. 13, doi: 10.3389/fphar.2022.979890.
17. **Zhang J., Zhou F., Liu Y., Huang F., and Zhang C., 2020 -** *Effect of extracellular polymeric substances on arsenic accumulation in Chlorella pyrenoidosa*, Science of the Total Environment, vol. 704, doi: 10.1016/J.SCITOTENV.2019.135368.