TYPHA SPECIES – A VALUABLE PLANT RESOURCE WITH THERAPEUTIC AND ECOLOGICAL POTENTIAL

Maria GÎTEA[1], Antonia Cristina PAŞCA[2], Iulia Ana PAŞCA[2#], Marc GHITEA[1], Daniela GÎTEA[3]

[1] Department of Medicine, Faculty of Medicine and Pharmacy, University of Oradea, Nicolae Jiga Street 29, 410028 Oradea, Romania
[2] Faculty of Medicine, University of Medicine and Pharmacy "Iuliu Hatieganu" Cluj-Napoca, Victor Babeş Street 8, 400012 Cluj-Napoca, Romania
[3] Department of Pharmacy, Faculty of Medicine and Pharmacy, University of Oradea, Nicolae Jiga Street 29, 410028 Oradea, Romania

ARTICLE

Abstract
Typha species, commonly known as cattails, represent one of the most versatile and ecologically valuable genera of wetland plants. Their wide distribution, rapid vegetative propagation, and high biomass productivity make them essential components of marsh ecosystems, while their traditional medicinal uses justify renewed scientific interest. This study aimed to investigate the morphological, anatomical, and qualitative characteristics of Typha spp., with particular focus on Typha angustifolia and Typha latifolia, which are widespread in Romania's wetland ecosystems. Plant material was harvested from local aquatic habitats and subjected to macroscopic and microscopic examination to document diagnostic features relevant for botanical identification and potential pharmacognostic applications. Macroscopic analysis confirmed species-specific traits regarding root system organization, leaf morphology, and inflorescence structure. Microscopic evaluation highlighted characteristic anatomical tissues, including aerenchyma, vascular bundle configuration, fibres, and secretory structures that support both ecological adaptation and possible therapeutic uses. The practical findings were correlated with data from traditional medicine and phytotherapeutic literature, emphasizing the plant's historical roles in wound care, haemostatic applications, and nutritional use of rhizomes. Given its ecological resilience, Typha also emerges as a promising natural resource for bioremediation, sustainable biomass production, and future phytopharmaceutical development. Overall, this study contributes to the understanding of Typha spp. by integrating field observations with pharmacognostic analysis, reinforcing its dual value as a medicinal resource and ecological stabilizer.

Keywords: *Typha species; cattail; medicinal plants; pharmacognosy; ecological potential.*

#Corresponding author:
iuliapasca1405@gmail.com
Iulia-Ana PAŞCA

INTRODUCTION

Species of the genus *Typha (Typhaceae Family),* widely known as cattails, are dominant emergent macrophytes in freshwater wetlands across Europe, Asia, Africa and the Americas (Szabo, 2007). Their ecological value is well established: *Typha species* (TS) stabilize riverbanks, reduce water turbidity, contribute to nutrient cycling and create habitats for diverse aquatic organisms. Their remarkable expansion capacity derives from robust rhizomes and efficient vegetative propagation, allowing them to colonize a wide range of marsh, lake and river-edge ecosystems (Ostapkowicz et al., 2001). Beyond their ecological role, TS have a long history of ethnobotanical and medicinal uses (Oroian, 2004). Traditional medicine reports indicate applications of rhizomes as demulcents, wound-healing agents, haemostatics, and supportive treatments for gastrointestinal conditions (Liu et al., 2025; Temelie, 2005). Aerial parts have been used for padding, crafts and fuel, while the inflorescence has been historically applied in wound management (Austin, 2007). Contemporary phytochemical studies reveal the presence of carbohydrates, fibres, phenolic compounds, flavonoids, and minor lipid fractions, suggesting potential antioxidant and anti-inflammatory activities (Liu, 1986; Shukla et al., 2012; Li et al., 2022). Despite their abundance in Romania where *Typha angustifolia* (TA) and *Typha latifolia* (TL) are commonly found in the Danube Delta and numerous wetland areas scientific

characterization remains limited (Ardelean, 2008; Bojor et al., 1982). A clearer understanding of their structural, anatomical and qualitative features is essential both for pharmacognostic identification and for evaluating their therapeutic relevance.

The objective of this study was to document the macroscopic and microscopic characteristics of TS, based on plant material collected from natural habitats, and to integrate these findings with known ecological and traditional medicinal uses. The study emphasizes TS dual value as a plant with therapeutic potential and a biologically valuable ecological resource.

MATERIAL AND METHOD

Plant material from TS (rhizomes, stems, leaves, inflorescences) was collected from wetland habitats characteristic of stagnant or slow-flowing waters, following good harvesting practices for medicinal plants. Only healthy samples, free of mechanical damage or fungal contamination, were selected. Rhizomes were collected in early spring, while aerial parts were harvested during the active vegetation period. Samples were washed, cleaned of soil and debris, and dried at room temperature in well-ventilated conditions. The dried material was further processed by sectioning or preparing thin slices appropriate for microscopic examination. Comparative evaluation of TA and TL based on taxonomic traits described in the literature, was included (Sârbu, 2013; Paşca et al., 2025).

Macroscopic Analysis

Macroscopic analyses were conducted following standard pharmacognostic procedures, with systematic evaluation of organ morphology, size, colour, texture, and the presence of latex. The examination adhered to the specifications of the Romanian Pharmacopoeia, 10th edition, which include the assessment of external appearance, characteristic odour, and taste for each vegetal organ (Ph.10^{th}). The plant material was manually cleaned, air-dried at room temperature, then mechanically fragmented and stored in paper envelopes under controlled environmental conditions until analysis (Szabo, 2007; Pallag, 2015).

Microscopic Analysis

For anatomical investigations, thin hand-made transverse sections were prepared from rhizomes, leaves, aerial stems and inflorescences using sterile razor blades. Sections were cleared with chloral hydrate or glycerinated water to improve tissue transparency. Complementary preparations were stained with a hydroalcoholic Genevez mixture (Congo red and chrysoidine) for approximately 5 minutes, followed by repeated rinsing with distilled water to remove excess stain (Paşca et al., 2025; Szabo, 2004).

Microscopic observations were carried out with an Optika C-B10+ (24010) optical microscope (Ponteranica, Italy), fitted with 10×, 20× and 40× objectives and connected to an Optika B10 digital camera (Gîtea et al., 2023). For each plant organ, diagnostic tissues were identified in accordance with classical botanical and pharmacognostic criteria, including epidermis, collenchyma, parenchyma (with well-developed aerenchyma in aerated tissues), vascular bundles, supporting fibers, articulated laticifers, secretory canals and inulin-containing parenchyma (Pallag, 2015). Pollen grains were obtained by gently tapping mature inflorescences onto sterile glass slides and fixing the material in glycerin jelly. Photographic documentation of macroscopic and microscopic structures was captured using a Canon EOS R5 camera fitted with a Canon RF 35 mm F1.8 Macro IS STM lens; images were processed exclusively for clarity and scientific documentation (Paşca et al., 2025).

Representative voucher specimens were deposited in the Herbarium of the Faculty of Medicine and Pharmacy, University of Oradea, Romania, where they were registered in the NYBG Steere Herbarium reference system.

RESULTS AND DISCUSSIONS

Macroscopic Analysis

Both TA and TL displayed characteristic tall, erect stems (1–4 m), supported by thick, creeping rhizomes rich in storage substances. TA exhibited narrower leaves (4–10 mm), lighter green, with a slightly convex lower surface. TL presented broader leaves (1–2 cm wide), bluish-green, with a firm, fleshy texture. Inflorescences confirmed the classic monoecious structure: the male spike situated above the female spike, compact, cylindrical, with the two sometimes separated by a narrow sterile gap in TA. Female flowers formed dense brown cylindrical spikes bearing numerous elongated stigmas and later producing achenes with silky hairs contributing to wind dispersal. These macroscopic features are essential for

accurate field identification and align with published taxonomic descriptions

Microscopic Analysis

Microscopic analysis revealed a set of characteristic structural features across all examined vegetal organs. Transverse sections of the rhizomes displayed a well-developed parenchyma with extensive aerenchyma chambers, ensuring efficient aeration in flooded habitats. The vascular bundles, dispersed throughout the ground tissue as expected in monocotyledonous species, were accompanied by concentric sclerenchymatic fibers that conferred mechanical stability. In the aerial stems, the epidermis consisted of thick-walled cells, while the cortical region contained abundant aerenchyma. Numerous collateral vascular bundles were embedded in the parenchymatous matrix, reflecting structural adaptations that support buoyancy and resistance to hydric stress. Leaf sections exhibited a bilaterally symmetrical organization, with an epidermis covered by a thin cuticle, large aerenchyma lacunae that facilitated internal gas circulation, and parallel venation. The vascular bundles were sheathed by supporting fibers, features that are ecologically advantageous but also diagnostically relevant in pharmacognostic identification. Microscopic observations of reproductive structures showed that female flowers possessed elongated stigmas and fine trichomes contributing to effective seed dispersal. Pollen grains were ellipsoid and displayed a smooth exine, a morphology consistent with anemophilous pollination.

The therapeutic relevance and ethnobotanical insights associated with TS indicate a long-standing use of the plant in traditional medicine, particularly for wound healing, haemostatic applications, burn management and various digestive ailments. These uses can be partially explained by the biochemical profile of the rhizomes, which contain storage polysaccharides and mucilaginous components responsible for demulcent and anti-inflammatory effects. Additionally, the presence of dietary fibers and phenolic compounds may contribute to antioxidant activity, although current evidence is mainly empirical, underscoring the need for more systematic pharmacological investigations. From an ecological perspective, the ecological and applied potential of TS is substantial. The plants are well known for providing essential ecosystem services, including bioremediation through the uptake of heavy metals and excess nutrients, soil stabilization in wetland environments, and enhancement of local habitat diversity. Their robust biomass also supports sustainable uses such as traditional crafts, fuel production and the development of biodegradable materials.

The anatomical characteristics documented in this study, most notably the extensive aerenchyma network observable in rhizomes, stems and leaves, further substantiate the species' capacity for efficient gas exchange and pollutant absorption. These features align with existing ecological data and reinforce the suitability of TS for integration into constructed wetlands, phytoremediation systems and broader environmental engineering applications.

Table 1.

Macroscopic analysis results of *Typha angustifolia* (TA)

Vegetative organ	Aspect / Shape	Surface / Fracture	Dimensions	Colour	Odour / Taste
Roots	branched roots	uneven, fibrous surface	short, up to 10 cm	exterior light brown, interior yellowish	marsh-like odour, slightly sweet taste
Rhizomes	cylindrical rhizomes, dark brown	uneven, fibrous surface	long rhizomes up to 10 cm, thickness 1–2 cm	exterior dark brown, interior yellowish	pronounced marsh-like odour, sweet taste
Aerial stems	erect, cylindrical, without nodes	smooth surface, fibrous fracture	long, up to 2 m	dark green	characteristic odour and taste
Leaves	long, linear, slightly arched on the lower surface	smooth margin, parallel-veined surface	width up to 1 cm, length up to 2 m	green, similar to fresh grass	characteristic
Flowers	cylindrical inflorescences, elongated, unisexual (monoecious)	rough, hairy surface; small distance between the two types of inflorescences, ~3.5 cm	male spike 16 cm long, female spike ~12.5 cm	exterior dark brown	characteristic odour
Pollen	fine powder	smooth surface	100–200 microns	yellow-green	characteristic

Table 2.

MACROSCOPIC ANALYSIS RESULTS OF T*YPHA LATIFOLIA* (TL)

VEGETATIVE ORGAN	Aspect / Shape	Surface / Fracture	Dimensions	Colour	Odour / Taste
ROOTS	branched roots	uneven, hairy surface	long, up to 30 cm	exterior light brown, interior yellowish	marsh-like odour, slightly sweet taste
RHIZOMES	cylindrical rhizomes, light brown	uneven, fibrous surface	long rhizomes up to 30 cm, thickness 3–5 cm	exterior light brown, interior yellowish	pronounced marsh-like odour, sweet taste
AERIAL STEMS	erect, cylindrical, without nodes	smooth surface, fibrous fracture	long, up to 4 m	light green	characteristic odour and taste
LEAVES	long, linear	smooth margin, parallel-veined surface	width up to 2 cm, length up to 2.6 m	bluish-green	characteristic
FLOWERS	cylindrical, elongated, unisexual (monoecious) inflorescences	rough, hairy surface; the two types of inflorescences are not distant	male spike up to 29 cm, female spike up to 25 cm	dark brown exterior	characteristic odour
POLLEN	fine powder	smooth surface	100–200 microns	yellow-green	characteristic

CONCLUSIONS

TS represent multifunctional wetland plants with notable ecological, ethnopharmacological and practical relevance. The present study confirms the presence of defining morphological and anatomical characteristics essential for accurate species identification and emphasizes structural elements that support both ecological adaptability and potential medicinal applications. The abundant aerenchyma, well-developed vascular bundles and the typical cylindrical inflorescences provide reliable diagnostic features that can be incorporated into routine pharmacognostic assessment. Importantly, the comparative analysis between TA and TL revealed no major morphological or anatomical differences, suggesting a largely similar structural profile across the examined taxa. Traditional ethnomedical uses indicate potential therapeutic benefits especially in wound care and inflammatory disorders although further modern pharmacological studies are needed to substantiate these claims. Considering their widespread presence in Romanian wetlands and their dual ecological and therapeutic potential, TS constitute an accessible and valuable natural resource that warrants continued phytochemical, pharmacological and ecological investigation.

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