



## Pharmacognostic study on the morphological and microscopic characteristics of *Polianthes tuberosa* L., Flowers

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### Abstract

The present study focuses on the pharmacognostic evaluation of *Polianthes tuberosa* Linn. (Family: Agavaceae), an aromatic perennial herb widely utilized for its therapeutic and commercial value. The plant was collected from the Madurai region, Tamil Nadu, and authenticated for further examination. Pharmacognostic studies, including macroscopic, microscopic, and powder analyses, were performed according to WHO guidelines for quality control and standardization. Macroscopic evaluation revealed characteristic milky-white, tubular, waxy flowers with a strong sweet fragrance. Microscopic analysis of the floral parts (petals, ovary, and stamens) showed diagnostic features such as uniseriate epidermis, parenchymatous mesophyll, vascular bundles, osmophore cells, and tricolpate pollen grains. Powder microscopy confirmed the presence of parenchyma cells, pollen grains, and fibrous elements. These pharmacognostic parameters provide key diagnostic characters for the identification and authentication of *P. tuberosa*, ensuring purity and preventing adulteration in herbal formulations. The study establishes baseline data supporting further phytochemical and pharmacological investigations of this medicinally significant plant.

**Keywords:** Pharmacognostic, microscopic, macroscopic, organoleptic

### Introduction

*Polianthes tuberosa* L., commonly known as tuberose, belongs to the family Agavaceae. It is also referred to by its synonym *Agave amica*. In India, the plant is locally known as Rajanigandha, Nishigandha, or Nila Sampangi, while in other countries it is called Hawaiiin or Kupaloke. Taxonomically, it is classified under the kingdom Plantae and sub-kingdom Tracheobionta. It belongs to the division Magnoliophyta, class Liliopsida, sub-class Liliidae, and order Liliales. The genus *Polianthes* encompasses the species *tuberosa*, giving it the full scientific name *Polianthes tuberosa* L. This aromatic perennial is valued both for its ornamental beauty and its medicinal and industrial applications [1].

Different parts of *Polianthes tuberosa* contain diverse bioactive compounds with reported pharmacological activities. The aerial parts are rich in bisdesmosidic cholestane glycosides and new spirostanol saponins, showing uses in tumor management, cosmetics, laxative effects, cooling, sexual disorders, hair colour enhancement, emesis, and diuretic activity [2]. The bulbs contain glycosides and long-chain alcohols like tricosanol, traditionally used for gonorrhoea, anti-inflammatory purposes, antispasmodic effects, diuretic activity, emesis, and treatment of infant rashes [3, 4]. Fresh tubers have steroidal glycosides, including spirostanols (polianthosides B & C) and furostanols (polianthosides D–G), although specific pharmacological actions are not directly reported [5, 6]. The leaves contain tuberculactone, kaempferol, kaempferol derivatives, and alpha-D-glucoside, exhibiting antioxidant, anti-inflammatory, anticancer, cardioprotective, anti-arthritic, and antidiabetic activities [7]. Flowers are rich in aromatic compounds, methanolic extracts, and essential oils, used in perfumery, indoor fragrance, antibacterial activity against *Proteus mirabilis* and *E. coli*, and brain/heart stimulation in Ayurvedic practice [8].

### Material and Method

#### Collection and Preservation of Plant Material

Fresh flowers of *Polianthes tuberosa* Linn. were collected from Alanganallur and Alagarmalai regions of Madurai district, Tamil Nadu, India, during March 2025. The collections were made in the early morning to ensure maximum essential oil yield, selecting only fully bloomed flowers for uniform quality. The plants were grown under tropical conditions (25–35°C) at an altitude of 101 m above sea level (9.9252° N). The collected specimens were preserved in the Department of Pharmacognosy, College of Pharmacy, Madurai Medical College, Madurai, for further studies.

#### Authentication of Plant Material

The plant was authenticated by Dr. D. Stephen, Department of Botany, The American College, Madurai. A voucher specimen was deposited for reference.

#### Pharmacognostic Studies

Pharmacognostic evaluation was carried out for authentication and standardization as per WHO guidelines, including macroscopic, microscopic, and powder studies [9].

#### Macroscopic Evaluation

Organoleptic and morphological features such as colour, Odor, shape, size, and floral parts (androecium, gynoecium, petals) were examined according to standard pharmacopoeia methods.

#### Microscopical Evaluation

Free-hand transverse sections of petals, ovary, and stamens were prepared and treated with phloroglucinol and hydrochloric acid to observe lignified tissues. Diagnostic features were photographed under a compound microscope.

**Powder Microscopy**

Powdered flower material was examined microscopically, both with and without staining, after treatment with phloroglucinol and hydrochloric acid. Characteristic features such as parenchyma, xylem elements, and oil globules were identified [10].

**Result and Discussion**

**Pharmacognostical Studies**

Pharmacognostic studies mainly deals with the

authentication and standardization of herbal medicinal plants through macroscopical, microscopical characters, observations as prescribed by an authoritative source.

**Morphological Evaluation**

**Organoleptic evaluation**

The fresh flowers of *Polianthes tuberosa* Linn., were examined visually and by sensory evaluation as per pharmacopeial standards. The following characteristics were recorded:

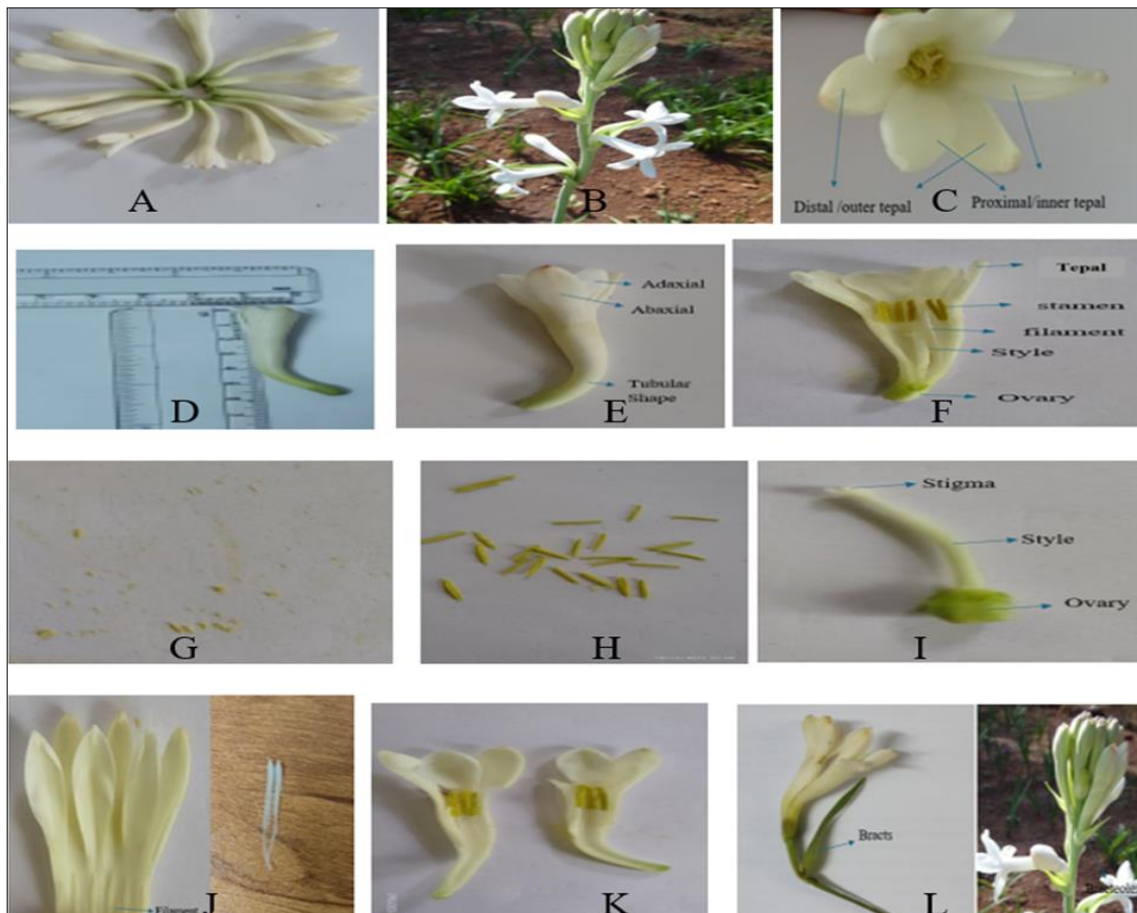
**Table:** Organoleptic evaluation of *Polianthes tuberosa* Linn.,

S. No	Parameter	Observation
1	Colour	Milky white
2	Odour	Strong, sweet, and pleasant floral fragrance
3	Size	Approximately 4.5–6.5 cm in length
4	Shape	Tubular, elongated with six petal lobes
5	Taste	Slightly bland to tasteless (not prominently used for taste)
6	Texture	Smooth, waxy, and soft

**Organoleptic and Morphological Characters**

The flowers of *Polianthes tuberosa* Linn. (Family: Amaryllidaceae), commonly known as tuberose, were evaluated for their organoleptic and morphological characteristics as part of pharmacognostic standardization. The flowers are milky white, tubular, and highly fragrant, with a pleasant, sweet aroma primarily attributed to the presence of volatile terpenoids and esters in the essential oil. The texture is smooth, waxy, and soft, indicating high

moisture content and intact cellular structure essential for volatile oil retention. The flowers measure approximately 4.5–6.5 cm in length, with six tepals (undifferentiated sepals and petals) arranged in two whorls of three. The taste is bland, aligning with its non-culinary use and preference in perfumery and therapeutic formulations. These organoleptic features correspond well with standard monographic descriptions and serve as reliable diagnostic markers for quality control and authentication.



A) *Polianthes tuberosa* flowers, B) Inflorescence of the *P. tuberosa* flower, c) Top view of a fully bloomed mature *Polianthes tuberosa* flower showing distinct distal (outer) and proximal (inner) tepals, three each in number, D) Size (4-6cm), E) Adaxial and abaxial surfaces of tepals, F) Floral parts of *polianthes tuberosa*, G) Pollen, H) Anther, I) Female reproductive parts, J) Filament of *P. tuberosa*, K) Radial symmetry, L) Bracts and Bracteole

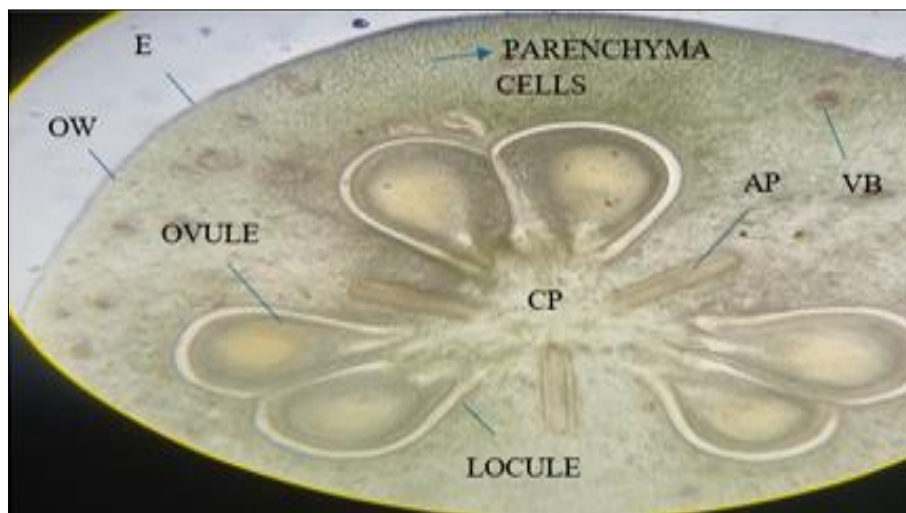
**Floral Morphology**

The inflorescence is a spike bearing multiple sessile, tubular flowers on a central axis (peduncle) up to 1 meter in height. Each spike contains 20–30 flowers arranged in pairs with small bracts and bracteoles at the base. Flowers are actinomorphic and bisexual, possessing both male and female reproductive organs. The perianth is funnel-shaped, with a long tube (up to 6 cm) that bends near the base and expands into six flaring lobes. The adaxial surface (inner) is more fragrant than the abaxial (outer) surface, indicating differential volatile emission.

**Reproductive Organs**

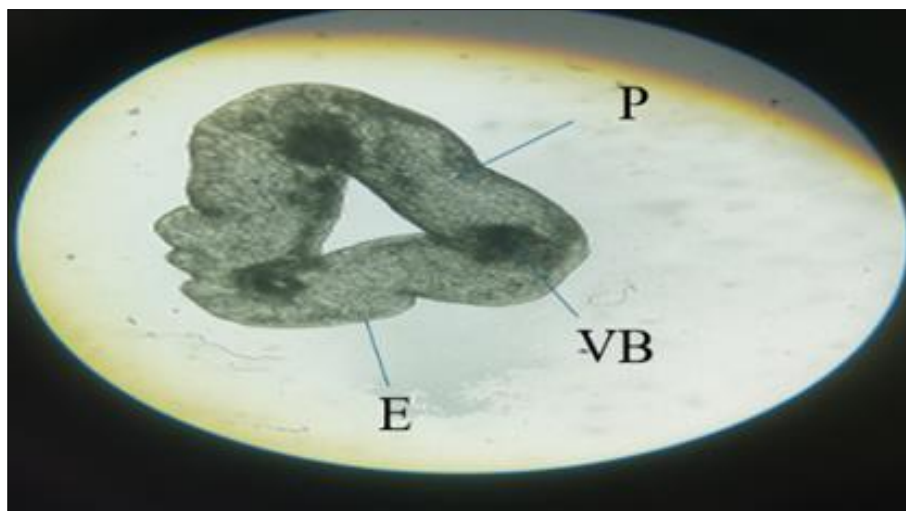
The androecium consists of six epitepalous stamens with dorsifixed anthers enclosed within the floral tube. The anthers are ditheous, basifixed, and dehisce introrsely to release tricolpate pollen grains. The gynoecium is trilocarpellary, syncarpous, and inferior, with a trilobular ovary containing numerous ovules on axile placentation. A single style arises from the ovary and terminates in a trifid, papillate stigma. Despite structural readiness for reproduction, natural fruiting is rare, likely due to self-incompatibility or pollination barriers.

**Transverse Section of Ovary**



Transverse section of ovary. E-epidermal layer, CP-central parenchyma, AP-axile parenchyma, OW-ovary wall, Locule, Ovule.

**Transverse Section of Stigma**



Transverse section of filament. VB-vascular bundles, P-parenchyma cells, E-epidermal cells (outer layer)

**Symmetry and sexuality**

The flower is actinomorphic (radially symmetrical) and complete, possessing all four floral whorls perianth, androecium, and gynoecium. The structural arrangement and tubular shape facilitate insect-mediated cross-pollination, particularly by nocturnal pollinators such as moths.

**Bracts and Bracteoles**

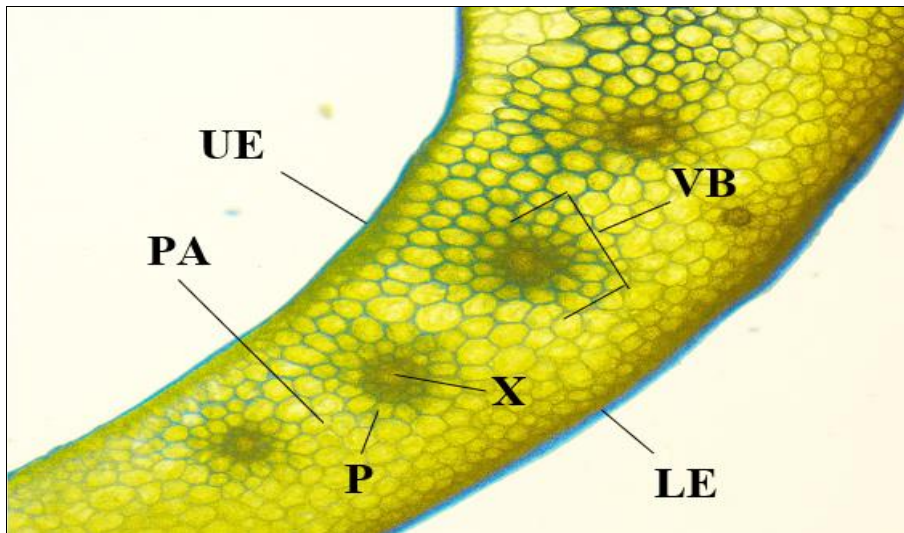
Bracts are small, leaf-like structures subtending the flower pairs, while bracteoles occur below individual flowers. Both play roles in bud protection, support, and possibly in pollinator attraction through subtle visual cues.

**Microscopical Evaluation Flower Parts**

**Transverse Section**

Thin free hand transverse sections of fresh flower parts such as petals, ovary, stamen. For identification of various contents, they were treated with phloroglucinol and hydrochloric acid. Photomicrographs were taken by using microscope.

**Transvere Section of Tepals**



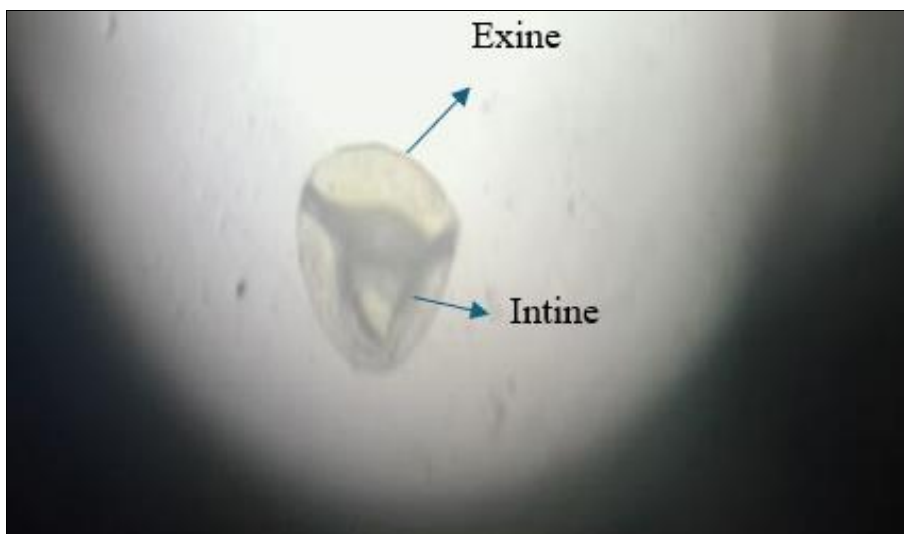
Transverse section of tepals. PA -parenchyma cells, X-xylem, LE-lower epidermal, UE- upper epidermal, VB-vascular, P- Phloem.

**Epidermal Layer of The Flowers Tepals**



Transverse section of epidermal layer of the flower

**Microscopical Pollen**



Microscopical view of pollen

### Transverse Section of Ovary

Microscopic observation of the ovary revealed a multilayered organization typical of monocots. The outermost epidermal layer consists of compact, small cells covered with a cuticle, serving as a protective barrier. Beneath it lies a zone of parenchymatous tissue interspersed with vascular bundles (xylem and phloem) that facilitate nutrient transport. The ovary exhibits axile placentation, with three distinct locules, each containing multiple ovules attached to a central placenta. Within the ovule, the nucellus surrounds the megaspore mother cell, which undergoes meiosis to form the embryo sac. Supporting structures include integuments, hypodermal parenchyma, and hypostases that assist in nutrient transfer during ovule development.

### Transverse Section of Stigma

The stigma shows an epidermal outer layer composed of compact cells with papillae and mucilage, facilitating pollen adherence and hydration. Beneath lies a parenchymatous transmitting tissue, which secretes nutrients for pollen tube growth and connects the stigma to the style. The presence of vascular bundles within the stigma confirms its active role in supporting pollen germination.

### Transverse section of tepals

Tepal sections revealed uniseriate upper and lower epidermis (UE, LE) with a smooth, cuticular surface, providing mechanical strength and preventing desiccation. The parenchyma beneath contains thin-walled cells with intercellular spaces, functioning in storage and pigmentation. Vascular bundles composed of xylem and phloem ensure nutrient supply. Specialized osmophore cells were noted in the epidermis, responsible for volatile oil secretion and fragrance release, indicating active scent-emission zones.

### Epidermal layer observation

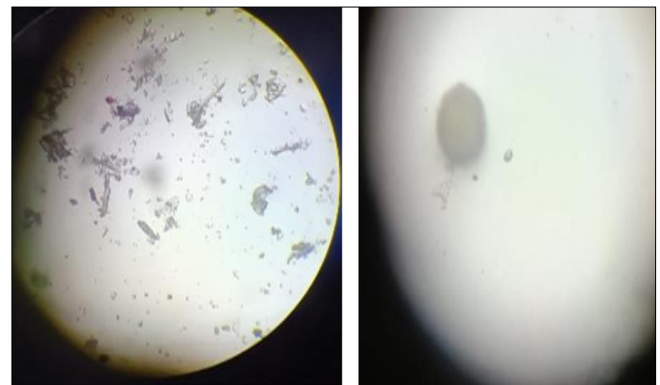
The epidermis comprises polygonal, tightly packed cells without trichomes or stomata, typical of floral tepals. The presence of osmophore glands with papillate structures and cuticular thickening suggests eocrine secretion of essential oils, a distinctive feature of *P. tuberosa*'s aromatic property.

### Pollen morphology

Microscopic analysis revealed tricolpate pollen grains, generally spherical to triangular, with a thick exine composed of sporopollenin and a thin intine beneath. The exine displayed three furrows or apertures for pollen tube emergence. The cytoplasm contained a vegetative cell supporting pollen tube growth and a generative cell for fertilization. These features are consistent with dicot pollen structure, despite *P. tuberosa* being a monocot, suggesting adaptive divergence.

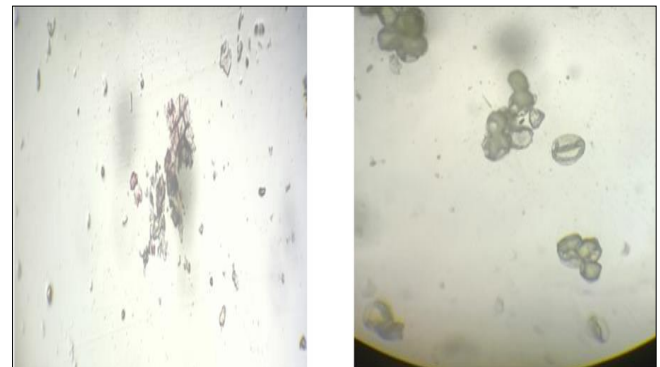
### Powder Microscopy

A pinch of powdered flower on a slide. For identification of various contents, they were treated with phloroglucinol and hydrochloric acid.



Fibers

Unmaturred pollen



Parenchyma

cellsMatured pollen

Microscopic examination of the flower powder demonstrated several diagnostic features useful for quality evaluation. Observed elements included fibres, immature and mature pollen grains, and parenchyma cells.

- **Fibres:** Long, slender, thick-walled sclerenchymatous structures providing mechanical support.
- **Immature Pollen:** Small, smooth, thin-walled, and less ornamented grains with dense cytoplasm.
- **Mature Pollen:** Larger grains with ornamented exine and distinct pores or apertures for tube formation.
- **Parenchyma Cells:** Thin-walled, isodiametric living cells with storage and metabolic functions, often appearing as large, rounded forms under observation.

### Acknowledgement

We express our deep sense of gratitude to Professor and faculty members of Department of Pharmacognosy, College of Pharmacy, Madurai Medical College for providing the guidance to carry out the studies.

### Conclusion

The pharmacognostic evaluation of *Polianthes tuberosa* Linn. successfully established key morphological, anatomical, and microscopic features essential for its authentication and standardization. Macroscopic characteristics such as tubular, milky-white, fragrant flowers, and microscopic observations including specialized osmophore cells, tricolpate pollen, and distinctive vascular arrangements provide reliable diagnostic markers. Powder microscopy further confirmed the presence of parenchyma, fibers, and pollen grains, reinforcing its quality parameters. These comprehensive studies not only ensure the correct identification and prevention of adulteration but also lay a strong foundation for future phytochemical, pharmacological, and commercial investigations, highlighting the plant's potential as a source of bioactive compounds with medicinal and aromatic applications.

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