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Exploring The Versatility and Medicinal Potential of *Tradescantia Pallida* (Purple Heart): Traditional Uses and Modern Applications

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Abstract

Tradescantia pallida — the spiderwort, a perennial herb native to eastern Mexico Gulf coast, at present farmed as an ornamental commonly known as purple heart or purple queen. Because of its pendulous nature, it is commonly grown in green house or outdoors as groundcover or in containers. The plant is part of the genus Tradescantia in the Commelinaceae family, which comprises approximately 80 herbaceous species endemic to Neotropics. Although T. pallida is recognized in the Food Technology and Environmental area for its uses of identifying, binding and elimination work for soil; air contaminants. The research was also done on bioactive compounds, such as epigallocatechin and hydroxytyrosol that have anticancer, anti-inflammatory activity and antidiabetic & antioxidative. Most notably these phytochemicals, and others from Tradescantia give some of the numerous potential uses for this plant, which may be evidence that its bioactive components are synergistic. For millennia, herbs have been a valued food, flavoring and healing plants these days they are widely used in the form of powders or capsules, teas and extracts. The Tradescantia genus is particularly famous for its traditional medicinal properties against different diseases, traditionally anti-inflammatory and antioxidant- antibacterial, antiarrhythmic. Traditionally, Its roots have been brewed in drinks to cure some digestive and kidney disorders, while the leaves were traditionally used in the treatment of bug bites or stings. Individual species such as T. zebrina are used in Traditional Chinese Medicine for the treatment of chloasma, and throughout Jamaica; T. pallida has been taken for the treatment of tuberculosis, coughs and hypertension. One of the decoctions of its leaves, is used to prepare the beverage "Matali" in Mexico. Usually these plants are herbaceous, 30–60 cm tall with perennial or annual fibrous- to tuberous-rooted stems that give rise dense mats. Flowers are bisexual, actinomorpic or slight zygomorphic and has its own unique inflorescence. Those traditional uses of Tradescantia species may be widespread and clear, but further scientific work is needed to substantiate the cause-effect relationship underlying the supposed medicinal benefits

Keywords: Tradescantia pallida, Bioactive compounds, Phytochemicals, Medicinal properties, Environmental applications, Traditional uses.

1.INTRODUCTION

Figure 1. *T.pallida* plant

The spiderwort species *Tradescantia pallida* is indigenous to eastern Mexico's Gulf Coast. This species is a perennial herbaceous one that tends to trail. Widely planted as a houseplant, outdoor container plant, or garden groundcover, the cultivar *T. pallida* 'Purpurea' is also known as purple heart or purple queen. **(1,2)** The species has been utilised in food technology and has shown promise in identifying and eliminating soil and air contaminants. Known by most as "Spiderwort," the genus Tradescantia is the second biggest in the Commelinaceae family, with about 80 herbaceous species **(3,4)** divided into 12 divisions. These species are native to the Neotropics, with Mexico and the southern United States serving as the centres of variety.

D.R. Rose classed it in the genus Tradescantia after Joseph Nelson Rose previously designated it Setcreasea pallida in 1911. In 1975, Hunt visited the Royal Botanic Garden Kew. **(5,6)** S was the previous name. Pallida or S. Purpurea is still used often. This herbaceous plant, which belongs to the Commelinaceae (spiderwort) family, is commonly referred to as purple heart or purple heart wandering jew. It is also sometimes called 'Moses in the Basket,' **(7,8)** though this usually refers to a different species. This low-growing carnivorous plant is hardy in zones 7–10, but it can also be grown as an annual or houseplant in colder climates. **(9)**

2.Taxomonic classification

Table.1. A systematic position of *Tradescantia pallida* (Purple Heart)

Rank	**Taxonomic Classification**
Kingdom	Plantae
Division	Magnoliophyta (Angiosperms)
Class	Eudicots
Order	Commelinales
Family	Commelinaceae
Genus	*Tradescantia*
Species	*T. pallida*

Taxation The spiderwort species *T. pallida* belongs to the Commelinaceae family. **(10)** One of the most prominent US plant collectors of his era, Edward Palmer, collected the type specimen in the Mexican state of Tamaulipas (maybe close to Ciudad Victoria in 1907). Joseph Nelson Rose described the species in 1911. He assigned it to the Setcreasea genus. David Hunt moved the species to the Tradescantia genus in 1975. Setcreasea purpurea was also considered a cultivar of S. pallida by Hunt. T. pallida **(11,12)** is still frequently referred to by the latter names.

3.Morphological description of purple queen

Tradescantia species can grow up to 30–60 cm tall and are either rupicolous or epiphytic, perennial or annual, and evergreen. Roots can be fibrous or tuberous, **(13,14)** and they can be thin or thick. Stems create dense, interlaced mats and are airborne, seldom subterranean, prostrate, **(15,16)** and have an ascending or upright tip. Simple, glabrous, sessile to sub-sessile, distichously or spirally alternating, lanceolate to linear-lanceolate to ovate, and uniformly spaced along the stem or crowded at the apex, the leaves **(17,18)** range in length from 3 to 45 cm. The terminal crescent inflorescence is pedunculated, subumbelled, and has reduced (bracteous) spataceous cincinni bracts that resemble leaves. Bisexual, pedicellate, pedicel glabrous, green, and actinomorphic or somewhat zygomorphic **(19,20)** are the characteristics of the flowers. Green, equal or subequal, polysepalous or connate below, and persistent are the characteristics of sepals.

Figure 2. Plant part of *T.pallide*
a. stem b. leaves c. flower

Table.2. Morphological description of the purple queen plant.

Character	**Description**
Plant Habit	Can grow up to 30–60 cm tall, perennial or annual, evergreen, rupicolous or epiphytic.
Roots	Fibrous or tuberous, thin or thick.
Stems	Dense, interlaced mats, airborne, prostrate, seldom subterranean, with an ascending or upright tip.
Leaves	Simple, glabrous, sessile to sub-sessile, distichously or spirally alternating, lanceolate to linear-lanceolate to ovate, 3–45 cm long. Uniformly spaced along stem or crowded at apex.
Inflorescence	Terminal crescent, pedunculated, subumbelled, with reduced spataceous cincinni bracts resembling leaves.
Flowers	Bisexual, pedicellate, glabrous pedicel, green, actinomorphic or somewhat zygomorphic.
Sepals	Green, equal or subequal, polysepalous or connate below, persistent.
Petals	Vivid blue, can also be white, pink, or purple, equal or subequal, free or connate beneath floral tube.
Anthers	Oblong or reniform, basifixed or dorsifixed, filaments free, typically bearded at the base, glabrous or with moniliform hyaline trichomes at the base.
Stamens	Equal or subequal, epipetalous.
Ovary	Pubescent, 3-locular, straight-styled, cylindrical to sub-cylindrical, glabrous.
Fruit	Loculicidal capsule, 3 cells, with one to two reniform to ellipsoid seeds per locule.

The majority of petals are vivid blue, although they can also be white, pink, or purple, equal or subequal, free or connate beneath the floral tube, **(21,22)** and they might be white, pink, or purple. Anthers are oblong or reniform, basifixed or dorsifixed, filaments free, typically bearded at the base, glabrous or with moniliform hyaline trichomes at the base, and stamens are equal or subequal and epipetalous. **(23,24)** Pubescent, ovary 3-locular, straight-styled, cylindrical to sub-cylindrical, and glabrous are the characteristics of carpels. The fruit is a loculicidal capsule with three cells. One to two reniform to ellipsoid seeds, typically rugose, per locule. **(25,26)**

4.Characteristics


Figure 3 Flowering plant structure of *T. pallida*

On fleshy stalks, dark purple, lance-shaped leaves up to 7" long are produced alternately. Pale hairs cover the plump leaves, which surround the stem like a sheath. Because of their fragility, the stems are easily broken off by vigorous kicking or brushing. **(27,28)** It will die back to the ground in colder climates throughout the winter, but in the spring it will reappear from the roots. The sprawling plants can grow much broader but only reach a height of around a foot.

The rather insignificant pink or pale purple blooms with vivid yellow stamens are produced at the ends of the stalks from midsummer to autumn and occasionally at other times. Typical of this species, these ½" diameter blooms feature three petals **(29,30).**

Purple hearts can be used as a houseplant, a trailer in mixed containers, a ground cover, or a cascade in baskets. They will spread very quickly and are best used in large quantities for in-ground plantings. When paired with other plants' pink, light purple, or burgundy blooms, the purple leaves make a striking contrast to gold, chartreuse, or variegated foliage **(31,32).** For striking pairings, pair it with scarlet begonias, orange marigolds, or chartreuse coleus.

Place it in a container with light green asparagus fern, golden creeping Jenny (Lysimachia nummularia 'Aurea' or other types), or "Marguerite" beautiful sweet potatoes. Or pair it with coral-coloured scarlet sage (Salvia coccinea 'Coral Nymph'), pink petunias, or lavender or pink verbena. **(33,34)** Additional recommendations for harmonic pairings with plants that have pink or purple flowers are Mexican petunia (Ruellia brittonia), lantana, scaveola, vinca (Catharantheus roseus), and four o'clocks (Mirabilis jalapa).

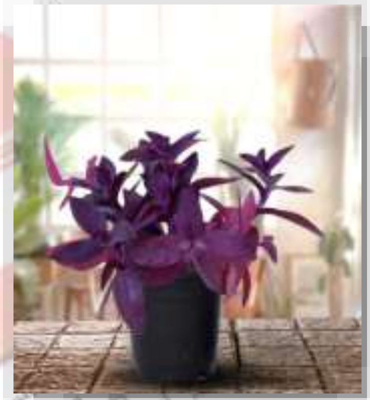
Figure 4 Structure *of T. pallida* under shade

Plants that grow in shade tend to turn more green than purple, so grow purple hearts in full sun for the optimum colour development. To encourage more compact growth, pinch the plants. In addition to thriving on neglect and drought tolerance, plants can withstand regular watering. When growing, fertilise every month. To keep plants from becoming spindly, **(35,36)** trim them back after they have flowered. Reduce watering over the winter and wait to fertilise until new growth begins in the spring if the plants are houseplants or are in pots to be kept indoors during the winter. Although purple heart has few pests, mealybugs and scales can be an issue. Although it is not a typical issue, some people and canines may experience skin redness and irritation **(37,38)** from the juice of the leaves or stems.

The most extensively researched species in the Tradescantia genus are *T. zebrina Bosse*, *T. fluminensis Vell.*, *T. spathacea Swartz,* and *T. albiflora Kunth.* **(39,40)** Tradescantia is used ethnopharmacologically for its anti-inflammatory, antioxidant, antimicrobial, and antiarrhythmic properties. **(41,42)** Every portion of the plant has potential uses, and while some species have had their phytochemical characterisations recorded, the majority of Tradescantia species have not. Other than toxicity research, **(43,44)** no species have been investigated for medication development. Therefore, this review's goal is to outline every known feature of the genus Tradescantia, including its botanical traits, traditional use, phytochemical makeup, biological activities, and safety considerations.

5.Conventional uses

Herbs have long been utilised for their flavour, aroma, and medicinal qualities. These days, fresh or dried herbs have been used in tablet or capsule form (powders, teas, and extracts). **(45,46)** The genus Tradescantia contains plants that have been utilised historically for their alleged anti-inflammatory, antioxidant, antibacterial, and antiarrhythmic qualities. Roots, for instance, have been used as a beverage to treat digestive and kidney disorders. **(47,48)**

Table.3. Represent the breakdown of the traditional uses, geographical regions and health benefits.

Plant species	**Traditional Uses**	**Geographical Regions**	**Health Benefits**	**Scientific Considerations**
Tradescantia spp. (general)	Flavor, aroma, medicinal properties	Worldwide	Anti-inflammatory, antioxidant, antibacterial, antiarrhythmic. Roots for digestive and kidney issues. Leaves for bug bites and stings.	Scientific proof is required for validating these uses.
T. zebrina	Kidney issues, digestive disorders, high blood pressure	Traditional Chinese Medicine, Jamaica	Anti-inflammatory, anti-kidney infection, anti-haemorrhoid qualities. Treats TB, cough, high blood pressure.	Requires further scientific study to prove efficacy.
T. zebrina (leaves)	Beverage to treat digestive and kidney disorders	Worldwide	Anti-inflammatory, kidney infection, haemorrhoids. Leaves used as tea by Filipinos for blood purification and to alleviate influenza.	More research needed on its effectiveness.
T. zebrina (Jamaica)	Treatment for TB, cough, high blood pressure	Jamaica	Treats tuberculosis (TB), cough, high blood pressure.	Needs scientific validation to support medicinal use.
T. pallida D.R. Hunt	Anti-inflammatory, antitoxic, blood circulation	Worldwide	Improves blood circulation, reduces eye strain.	Requires scientific research to confirm medicinal properties.
T. spathacea (Rhoeo spathacea)	Treatment for haemoptysis, dysentery, bronchitis, cough	China, Singapore	Used to treat haemoptysis, dysentery, bronchitis, cough, and fever.	Negative side effects reported (skin, eye irritation).
T. spathacea (sap)	Skin and eye irritant, oral and stomach pain when consumed	Singapore, China	Negative side effects: skin irritation, eye irritation, stomach and oral pain if ingested.	Negative effects need consideration in medical use.
T. spathacea (decoction)	Treatment for bronchitis, cough, fever	Singapore	Cures bronchitis, cough, and fever through decoction of leaves and flowers.	Needs scientific validation for therapeutic potential.

Leaves have been used to treat bug bites and stings. An overview of the genus Tradescantia's traditional applications around the world. As potential uses for this plant source, traditional treatments must be carefully understood and taken into account. Therefore, to show the cause-and-effect relationship **(49,50)** of these traits, scientific proof is required.

For illnesses of the renal system, T. zebrina has been utilised extensively in traditional Chinese medicine. This herb has been used in Jamaica to treat TB, cough, and high blood pressure. **(51,52)** The leaves are specifically thought to offer anti-inflammatory, anti-kidney infection, and anti-haemorrhoid qualities. In Mexico, a cool beverage known as "Matali" is traditionally made from a decoction of the leaves.

Leaf extracts are used in the Caribbean to treat intestinal irritation and kidney and urinary issues. The leaves were once used as tea by the Filipinos to purify the blood and lessen the symptoms of influenza. **(53,54)** The plant was thought to have benefits for treating poisonous snake bites, leucorrhea, urinary tract infections, nephritis, and intestinal irritation. **(55,56)** Malaysians suggested a decoction of the herb to enhance kidney function. Additionally, T. pallida D.R. Hunt has been utilised historically for its anti-inflammatory and antitoxic properties, as well as for its ability to improve blood circulation and prevent eye strain. **(57,58)**

A decoction of fresh or dried leaves and flowers of T. spathacea, also called Rhoeo spathacea or Rhoeo disccolor, has been used in China to cure haemoptysis and dysentery**. (59,60)** This herb is traditionally used in Singaporean medicine to treat bronchitis, cough, and fever. Despite all of these benefits, its sap is said to have negative side effects, including skin and eye irritation, as well as stomach and oral pain when consumed**. (61,62)**

These conventional applications might point to the existence of possible bioactive substances (in their chemical makeup) that could stop or treat specific illnesses. **(63)** Since there isn't enough scientific proof to support such applications, the right scientific approaches must be used. These conventional applications can now be transformed into future.

6.Biochemical activity

The phytochemical makeup of Tradescantia species may be connected to the many bioactive characteristics reported for them. For example, a number of research studies have documented the bioactive characteristics of epigallocatechin, including its anticancer, anti-inflammatory, antidiabetic, and antioxidant effects. **(64,65)** Another phytochemical molecule with documented antioxidant, anti-inflammatory, anticancer, antidiabetic, or cardioprotective qualities is hydroxytyrosol**. (66,67)** Tan et al. recently examined a large number of the bioactive characteristics of certain chemicals found in Tradescantia plants, **(68)** emphasising the following compounds: A, B, and C latifolicin, hydroxytyrosol, rutin, epigallocatechin, (6S,9R)-roseoside, kaempferol**, (69,70)** oresbiusin A, protocatechuic acid, and ferulic, vanillic, chlorogenic, and p-coumaric acid**. (71,72)** Other plant sources have identified kaempferol, protocatechuic acid, rutin, and epigallocatechin as anti-cancer and antioxidant substances**. (73,74)** The bioactive potential of Tradescantia extracts should be taken into account in the event that there are potential synergistic effects between components, even though individual compounds may have demonstrated bioactive qualities **(75,76)** of their own.

Table.4. Biological activities of *Tradescantia* species, with specific compounds and their actions.

Biological Activity	**Description**	**Key Findings**
Antioxidant Activity	Counteracts oxidative stress by neutralizing reactive oxygen species (ROS).	*T. zebrina* showed the highest antioxidant capacity (FRS: 906.5 mg AA/100g). *T. pallida* also demonstrated antioxidant properties, suggesting its potential in oxidative stress management.
Anti-inflammatory Activity	Reduces inflammation caused by infectious agents, often evaluated by nitric oxide (NO) formation.	*T. albiflora* compounds, such as methyl 3,4-dihydroxybenzoate and hydroxytyrosol, inhibited NO formation. *T. fluminensis* had an 87% inhibition of lipoxygenase, indicating strong anti-inflammatory potential.
Cytotoxic Activity	Evaluates the toxic effects of plant extracts on cell viability, particularly in cancer cells.	*T. zebrina* extracts showed varying cytotoxicity based on solvent. Zinc oxide nanoparticles (ZnO NPs) from *T. pallida* showed high cytotoxicity against cancer cells (HeLa cell line, 98.9% mortality).
Anticancer Activity	Investigates the ability to reduce cancer cell growth or proliferation.	*T. zebrina* reduced cancer cell proliferation in lung adenocarcinoma and squamous cell carcinoma lines. *T. spathacea* extracts showed anticancer potential in human breast adenocarcinoma (MCF-7).

Antibacterial & Antifungal Activity	Evaluates the effectiveness against harmful bacteria and fungi.	Methanolic extracts of *T. zebrina*, *T. pallida*, and *T. spathacea* inhibited bacteria like MRSA and *Proteus vulgaris*, and fungal growth including *Moniliophthora roreri* (cocoa pathogen).
Additional Biological Activities	Includes actions like antiarrhythmic, neuroprotective, and immune-modulating properties.	*T. zebrina* showed antiarrhythmic effects in rats. *T. zebrina* extracts inhibited acetylcholinesterase, suggesting potential for neurodegenerative diseases like Alzheimer's.

6.1. Activity of Antioxidants

As a tactic to counteract oxidative stress, the antioxidant content of food or vegetable sources has grown in importance. An imbalance between the generation of reactive oxygen species (ROS) in tissues and cells and the biological system's capacity to use antioxidant agents to repair the damage that results is known as oxidative stress. **(77,78)** Through the generation of peroxides and free radicals, which harm all cellular constituents, including proteins, lipids, and DNA**, (79,80)** this imbalance may have harmful repercussions. A variety of physiological antioxidant defence mechanisms, which comprise a complex collection of procedures meant to prevent or delay excessive oxidation at the cellular level and, in certain situations, reverse the oxidative damage of the impacted molecules, regulate the biological effects of ROS **(81,82)** in aerobic organisms. The antioxidant system contains a variety of compounds that are primarily categorised as either endogenous or exogenous antioxidants. **(83)** Numerous enzymes (such as glutathione peroxidase, catalase, superoxide dismutase, etc.) and non-enzymatic (such as glutathione, bilirubin, uric acid, etc.) substances are examples of endogenous antioxidants**. (84,85)** Vitamins (like A, C, and E), carotenoids (like lutein, zeaxanthin, and lycopene), phenolic compounds (like flavonoids and phenolic acids), glucosinolates, and organosulfur compounds are examples of exogenous antioxidants **(86,87)** that are mostly found in the diet. Numerous studies have concentrated on examining the antioxidant, anticancer, and anti-inflammatory potential of various families of compounds with potential antioxidant qualities found in natural sources, such as carotenoids or phenolic compounds, using in vitro cell lines **(88,89)** and animal models. The basis for phenolic compounds' antioxidant properties is their superior hydrogen-donating capabilities, which reactive radicals accept to produce far less active radical and non-radical species. **(90,91)**
Numerous techniques exist for assessing antioxidant capacity, including the 2,2-diphenyl-1-picrylhydrazyl test (DPPH), ferric reducing antioxidant power assay (FRAP), Trolox equivalent antioxidant capacity assay (TEAC), and oxygen radical absorbance capacity assay (ORAC). **(92,93)** A hydrogen atom transfer process is used in the DPPH and ORAC tests. **(94)** The ORAC assay tracks the suppression of oxidation caused by peroxyl radicals to determine an antioxidant's capacity to break radical chains. **(95,96)** The most common free radicals involved in lipid oxidation in dietary and biological systems are peroxyl radicals. The DPPH radical scavenging test relies on the polarity of the substrate and is a sensitive antioxidant test. **(97,98)** One possibility for radical scavenging and/or hydrogen donation is the presence of numerous hydroxyl functionalities. One consequence of ROS overproduction is ferroptosis, **(99,100)** In contrast to apoptosis, ferroptosis also results from a breakdown in antioxidant defence, which compromises cellular redox equilibrium. **(101,102)** TEAC and FRAP tests, on the other hand, rely on single-electron transfer. The reduction of Fe (III) to Fe (II) is the foundation of the FRAP process**.(103,104)** Ferroptosis and its detrimental effects on healthy cells may be controlled by antioxidants that can chelate and reduce iron (III) ions. **(105,106)** Tan et al. used ferrous ion chelating (FIC), phenolic ferric reducing power (FRP), and DPPH free radical scavenging (FRS) **(107,108)** assays to investigate the antioxidant activity of T. zebrina, T. pallida, and R. spathacea. T. zebrina exhibited the highest antioxidant capacity **(109,110)** values, according to their findings (FRS: 906.5 + 88.2 mg AA equivalent/100 g; FRP: 4.8 ± 0.3 mg GAE/g). According to Sinha et al., T. pallida has antioxidant properties that demonstrate its ability to fight oxidative stress. **(111,112)**

6.2. Activity of Inflammatory

The immunological reaction of a living thing to various infectious agents, such as bacteria or viruses, is known as inflammation. Common symptoms of inflammation include fever, discomfort, and redness. **(113,114)** Although synthetic medications have demonstrated effectiveness in reducing inflammatory processes, adverse effects are also frequently experienced. Many plant sources,**(115)** including some species of Tradescantia, have been investigated as prospective substitutes to reduce inflammatory processes because of their phytochemical makeup, which includes anti-inflammatory properties. **(116,117)** For instance, one of the species having anti-inflammatory properties has been found to be T. fluminensis, also referred to as Wandering Jew. **(118)** According to Tu et al.'s evaluation of the anti-inflammatory properties of chemicals derived from T. albiflora, methyl 3,4-dihydroxybenzoate, hydroxytyrosol, and bracteanolide **(119,120)** A have strong inhibitory potential against the formation of nitric oxide (NO) in a RAW 264.7 cell culture. Since NO generation takes place during inflammatory processes, it serves as a reliable gauge of the degree of inflammation. **(121,122)** 5-O-n-butyl bracteanolide A demonstrated the most anti-inflammatory potential of the three compounds **(123)** that were assessed.
The inhibitory action of lipoxygenase generated by leaf extracts from T. fluminensis and T. zebrina **(124,125)** was evaluated in a different investigation. Lipoxygenase contributed to the synthesis of lipid mediators, which were crucial for inflammatory processes. The most promising was T. fluminensis, which had an 87% inhibition value. **(126,127)**

6.3. Activity of Cytotoxins

Chan et al. used the neutral red uptake (NRU) and 3-(4,5 dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) tests to assess the cytotoxicity of six medicinal plants, including T. zebrina. **(128,129)** Six extracts made using various solvents—chloroform, ethanol, methanol, water, ethyl acetate, and hexane **(130,131)** —were assessed in this investigation. A monkey kidney epithelial cell (Vero) model was used to assess the cytotoxicity activity using extract concentrations ranging from 5 to 640 μ. g/mL. **(132)** The findings demonstrated that the aqueous, methanolic, and ethanolic extracts were less hazardous to Vero cells than the chloroform, hexane, and ethyl acetate extracts. **(133,134)**
Consequently, the findings demonstrated that the cytotoxicity of the assessed medicinal plants, including T. zebrina, varied according to the extraction solvent and concentration. **(135,136)** When assessing the cell viability of plant extracts, it was also found that the NRU assay had a higher degree of sensitivity and reproducibility than the MTT assay. **(137)** In order to assess the cytotoxic and fluorescent qualities of zinc oxide nanoparticles (ZnO NPs), Li et al. synthesised them using an aqueous leaf extract (TPALE) of T. pallida. **(138,139)** In particular, 80 mL of zinc acetate (1 mM) and 20 mg of TPALE were combined to produce nanoparticles. **(140)**
The pellet was subsequently boiled for five hours at 350 °C after the fluid was centrifuged. A number of methods, including X-ray diffraction, transmission electron microscopy, and scanning electron microscopy, were used to characterise the synthesised ZnO NPs.**(141,142)** The final rod-shaped particles were 25 ± 2 nm in size. The MTT assay was used to assess the nanoparticles' cytotoxic impact on a HeLa cell line. **(143,144)** The findings demonstrated that when a 1000 mg/mL dose of ZnO NP was administered, 98.9% of the cancer cells perished. **(145)**
This suggested that the cervical cancer cell line was more susceptible to the biogenic ZnO NP's improved cytotoxic properties, which may lead to its further development as an anticancer medication. **(146,147)** More research should be done to confirm the reproducibility of these results with a lower dose, though, as this dose is regarded as high.

6.4. Activity Against Cancer

Brauner et al. tested the anticancer properties of T. fluminensis and T. zebrina methanolic and aqueous extracts on the lung adenocarcinoma A549, squamous cell carcinoma SCC-13y, and human foreskin fibroblasts HFF-1 cell types **(148,149)**. According to the results, the rate of cancer cell growth decreased, particularly when T. zebrina was included in the treatment. Thus, this investigation validated T. fluminensis and T. zebrina's ability to suppress both cancerous and non-cancerous cells. **(150,151)** Using SCC-13y and A-549 cell cultures, Moehring et al. assessed the anticancer effects of T. zebrina methanolic and aqueous extracts. For five days, the number of cells was counted in order to determine how quickly the plant extract inhibited the cells. **(152,153)**
Both cell lines' cell proliferation was reduced, according to the data. To determine the extracts' relative toxicity, they were also tested against the HFF-1 non-cancerous cell line. **(154,155)** T. zebrina has shown the ability to suppress both cancerous and non-cancerous cells. **(156)**

Rosales-Reyes et al. used the carcinogenesis model of resistant hepatocytes in rats to assess the defences against liver cancer of a crude T. spathacea aqueous extract. **(157,158)** With a dosage of less than 20 mg/kg of body weight, the aqueous crude extract decreased the quantity and size of preneoplastic lesions. **(159)** The administration of the aqueous extract did not result in the establishment of altered hepatocyte foci or promoter or initiator effects. **(160)** In a different investigation, Prakash et al. assessed T. spathacea leaf extract's anticancer activity against the human breast adenocarcinoma cell line (MCF-7). **(161)** The findings demonstrated that at a dosage of 299.7 μg/mL, a 50% inhibition of MCF-7 **(162)** was found. According to Cai-Yun et al. the synthetic ZnO particles derived from T. pallida exhibited cytotoxic effects on a cervical. **(163,164)**

6.5 Antibacterial and Antifungal Properties

A significant cash crop used to make chocolate, cocoa has an impact on the environment, the economy, and society. Diseases and pests are two elements that have a big impact on cocoa bean quality. One of the primary pathogenic fungi that have been shown to impact the quality of cocoa trees is Moniliophthora roreri. **(165)** España et al. assessed the growth-inhibiting properties of extracts from T. spathacea, Origanum vulgare, and Zingiber officinale **(166)** in order to stop this phenomenon. Using concentrations of 40–50% of both fresh and dry plants, the results demonstrated that all three plants inhibited the growth of M. roreri conidia.Methanolic extracts of T. zebrina, T. pallida, and T. spathacea leaves demonstrated antibacterial efficacy against Proteus vulgaris, Bacillus, and methicillin-resistant Staphylococcus aureus. **(167,168)**

6.6. Additional Biological Activities

For a variety of Tradescantia species, additional biological activities have also been investigated. For instance, varying concentrations of a tea extract from T. zebrina (2.5–10% m/v) have been used to study the larvicidal action against Anopheles benarrochi. **(169)** After 24 hours of exposure, a median lethal concentration (LC50) of 0.86% was found.Chunxin et al. used aconitine as an arrhythmia inducer in rats to test the antiarrhythmic properties of β-ecdysone, which was isolated from T. zebrina. **(170)** The biologically active substances found in Tradescantia species have the potential to have strong antiarrhythmic effects, **(171)** according to this study. Assessed the methanolic extract of T. zebrina leaves' in vitro acetylcholinesterase inhibitory efficacy. **(172,173)** Numerous illnesses have been linked to this enzyme, including neurodegenerative conditions like Alzheimer's disease.

Acetylcholinesterase activity was shown to decrease significantly ($p < 0.05$) at doses of 100.00 and 10.00 μg/mL of extract, respectively, by 14.0 and 15.3%. **(174, 175)** .The impact of T. spathacea and seven species of medicinal plants on natural killer (NK) cells, a subset of innate immune system cells, was assessed by Sriwanthana et al. **(176)** When exposed to high doses in a dose-dependent way, all cells were found to greatly increase the proliferative responses of human lymphocytes. **(177,178)** The investigated plant species, according to the authors, stimulated human cells and significantly influenced the immunological response. **(179)**. Only a small number of the many species in the genus Tradescantia have undergone biological investigation; the most extensively studied species are T. zebrina, T. spathacea, T. fluminensis, and T. pallida. **(180,181)** In order to make more progress, it is generally required to keep researching the biological activities of Tradescantia species and to increase the number of assays in in vivo models. **(182)** To guarantee the reproducibility of the results described in this review, more research should be done. Studies on the phytochemical components' bioactivity, bioavailability, and bioaccessibility **(183)** are also required. Knowing which substances can enter the target tissues and have positive effects is crucial.

The bioactive qualities of these extracts or chemicals, which could be applied in contemporary medicine, are still not well understood. **(184,185)** . To strengthen scientific evidence and convert the traditional usage of these plants into applications in modern medicine or food, further research should be done on the bioactive qualities, bioavailability, metabolism, and long-term effects of Tradescantia extracts. **(186,187)**

7. Adverse Effects and Safety

Concerns Numerous physiologically active compounds are found in plants, some of which have been shown to have therapeutic benefits, while others have negative effects and are detrimental to human health. **(188,189)** The latter are typically secondary metabolites or low molecular weight endogenous toxins that plants make to defend themselves against insects, animals, and microbes. **(190,191)** Alkaloids, glycosides, proteins, and saponin glycosides are the four primary classes into which plant toxins are typically categorised according to their chemical structures. **(192,193)** Although there are few instances of negative reactions to the substances from this plant, the presence of phytochemicals such as alkaloids, flavonoids, tannins, and phenols in Tradescantia preparations suggests that the plant may have hazardous qualities. **(194,195)** This is because, in contrast to their pharmaceutical counterparts, the detrimental effects of herbaceous plants are far more regulated.

Tradescantia species are classified as belonging to the fourth class of toxicity by Filmer et al., meaning that its juice, sap, or thorns may irritate or cause skin rashes. **(196,197)** Crystals of calcium oxalate that are present in the parenchymal tissues of the stem, leaves, roots, and flowers may be the cause of this possible toxicity. **(198,199)** These crystals may be secreted by plant cells under humid conditions and may subsequently come into touch with the skin. **(200,201)**. There has only been one confirmed human case of a 32-year-old patient being allergic to Tradescantia species (T. albifloxia and T. fluminensis). The patient had swollen lips, an itchy face, throat, and conjunctiva**. (202,203)**

A methanolic extract of T. zebrina leaves has been shown to stimulate cytochrome (CYP) 3A4, an enzyme that breaks down medications in human liver microsomes, according to a recent study by Wang et al. **(204)** According to certain research, T. fluminensis may have negative consequences on dogs, including allergic responses (red, itchy skin). The impact of Tradescantia spp. on the human body system should be further confirmed by more in vivo research. **(205,206)** These plants have been used to make beverages and in traditional medicine, despite these few instances of potential harm to human health.**(207)** However, it is only possible to identify the primary bioactive chemicals of plants due to the absence of precise knowledge regarding the detrimental effects of whole plants or extracts derived from them on human health. **(208,209)**

In addition to being a phytochemical compound of Tradescantia spp., 3-epicyclomusalenol has also been identified as a phytochemical compound of brown algae (Kjellmaniella crassifolia) and bananas (Musa sapientum). **(210)** The Human Metabolome Database indicates that this chemical has no known adverse effects. **(211)** Although there is currently no information available regarding the biological side effects and interactions with ergosterol peroxide, which is likewise derived from the pineapple plant Ananas comosus and the fungus Ganoderma lucidum, it is a promising novel reagent to overcome drug resistance in cancer cells. **(212,213)** Green tea contains methyl 3,4-dihydroxybenzoate, an antioxidant polyphenol that reduces the harmful effects of fluoride on lung epithelial cells. **(214)** 4-Hydroxybenzoic acid is an antioxidant with minimal toxicity that can cause human breast cancer cells to produce more oestrogen. **(215,216)** According to reports, several phytosterols have cytotoxic effects on normal cells that are more or less severe. Even though β-sitosterol has been found to be safe, common side effects after consuming it include indigestion, nausea, and diarrhoea. **(217,218)** While β-sitosterol is not advised for use in children, pregnant women should avoid this substance due to its known uterine stimulating effects. Since sitosterol and other fats abnormally build up in the blood, it is well recognised that β-sitosterol should not be utilised in sitosterolemia. **(219,220)**

According to the latest findings in a mouse model, stigmasterol causes higher mortality, left ventricular dysfunction, cardiac interstitial fibrosis, and macrophage infiltration without atherosclerosis. **(221,222)** However, stigmasterol-rich plants are not a genotoxicity concern because the European Food Safety Authority (EFSA) states that there is no proof that phytosterols or phytosterol esters are mutagenic or genotoxic. **(223,224)** In conclusion, there are no pertinent toxicological data on plants in the genus Tradescantia; nonetheless, long-term human use of the plant preparations indicates no safety issues with oral or oromucosal use. Before products are put on the market, more toxicological research is required to confirm the safety of these plant matrices. **(225)**

8. Conclusion

To summarize, Tradescantia pallida in a tropical environment showcases the promise of plants in the decorative and healing medicine sphere. Although commonly known as a beautiful house and garden plant, its rich herbal history, together with recent discoveries of some of its more bioactive components, may show promise for a variety of ailments such as inflammation, oxidative stress and various cancers. However, to understand and appreciate the full medicinal graces of Tradescantia more research is required to demonstrate its medicinal potential and decipher how its bioactive compounds can work synergistically. These fields could be bridged by the age tools and findings from the differences between one tradition and modern science due to the learning gap.

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