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Review Article

A Comprehensive Review on *Tradescantia pallida:* Phytochemistry and Pharmacology

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Abstract: *Tradescantia pallida*, also known as Purple Queen, is a remarkable ornamental plant from the *Commelinaceae* family that boasts significant medicinal and ecological value. This review decisively underscores its phytochemical, pharmacological, traditional, and environmental applications, making it clear that consolidating existing knowledge and identifying areas for future research is essential. Extensive phytochemical studies have confirmed the presence of bioactive compounds like phenolics, flavonoids, and anthocyanins that drive its powerful antioxidant, antimicrobial, antifungal, and antidiabetic effects. It demonstrated cytotoxicity against tumor cells and effective larvicidal activity against *Aedes aegypti*, highlighting its essential roles in medical applications and pest control. In traditional medicine, *T. pallida* is well-recognized for its hepatoprotective, nephroprotective, and anti-inflammatory properties, which are fully supported by modern scientific findings. Moreover, its ability to synthesize therapeutic nanoparticles and produce natural dyes firmly establishes its significance in the field of green technology. Environmental studies robustly affirm its contribution to phytoremediation, air pollution biomonitoring, and soil detoxification, reinforcing its status as an eco-friendly solution. This review meticulously synthesizes information from esteemed databases such as PubMed, SciFinder, and Google Scholar, focusing on the most recent and impactful findings. By delving into its vast pharmacological activities and environmental applications, *T. pallida* emerges as a versatile resource poised for sustainable development. The plant's diverse properties present confident avenues for future research in medicine, industry, and ecological conservation.

Keywords: *Tradescantia pallida*, Phytochemical, Pharmacological properties

1.Introduction

Tradescantia pallida, commonly referred to as the purple queen, is a striking ornamental plant celebrated for its beneficial medicinal properties. It is often utilized for its anti-inflammatory and antitoxic effects, as well as to enhance blood circulation. Phytochemical analyses indicate that *T. pallida* is abundant in essential compounds

such as phenolics, flavonoids, tannins, alkaloids, and saponins. Additionally, it serves as a source of vibrant natural pigments, particularly anthocyanins[1]. *Tradescantia pallida* is a member of the family *Commelinaceae* which is also known as purple queen [2]. *T. pallida* grows annually in subtropical and tropical regions of Asian countries, including Pakistan, India, and Bangladesh [3]. The silver nanoparticles synthesized from the extract of *T. pallida* have antioxidant, antimicrobial, and antifungal activity. The volatile constituents of hexane extract are determined from *T. pallida* (HE-TP) aerial parts by gas chromatography spectrometry and gas chromatography-mass spectrometry flame ionization detection, which also shows antifungal activity. *T. pallida* also shows cytotoxic activity against tumor cells [4]. Many plants or parts of plants contain several activities. Availability of secondary metabolites, including flavonoids, in plants with antioxidant activity has been related to hepatoprotective effects [5]. Isoflavones, flavonoids, chalcones, and anthocyanins are among the common polyphenolic chemicals known as flavonoids; these latter compounds are found in particular species of *T. pallida* [6]. *Tradescantia pallida* plants are a rich source of bioinsecticide that causes cytotoxicity in *Aedes aegypti* (dengue mosquito), reducing the mosquito population.[7]. The use of *Tradescantia pallida* extract in the green synthesis of silver nanoparticles is possible. Due to the biological potency of *T. pallida* silver nanoparticles (TPAgNs), they are essential in assessing *T. pallida's* therapeutic potential [8]. *Tradescantia pallida* (Rose) D.R. Hunt offers a promising dual role as a natural alternative in aquaculture and a bio-monitor for air quality. The plant's bioactive compounds, such as phenolics and flavonoids, provide antimicrobial, antioxidant, and immune-boosting properties beneficial for aquaculture species [9]. Additionally, its phytoremediation capabilities enable it to absorb volatile organic compounds, making it an effective tool for improving indoor air quality and assessing environmental pollution through bioassays [10]. Synthesized nanoparticles provide antibacterial activity against gram-positive and gram-negative strains such as *E. coli*, *Staphylococcus aureus*, *Salmonella typhimurium*, and *Pseudomonas aeruginosa*, and for two antifungal strains, *Candida albicans* and *Aspergillus niger*. In this review, a scientific article from the last 5 years, including medicinal and evaluation of biological properties of *Tradescantia pallida* species through *in vitro* and *in vivo* models, is prioritized for subjection [11].

2. Materials and Methods

This literature review on *T. pallida* was compiled from literature from seven databases: SciFinder, PubChem, ScienceDirect, Scopus, PubMed, Google Scholar, and Web of Science. Articles included in the review were published in English before September 2024. Other records were discovered through other sources. Then, the duplicated records were expelled.

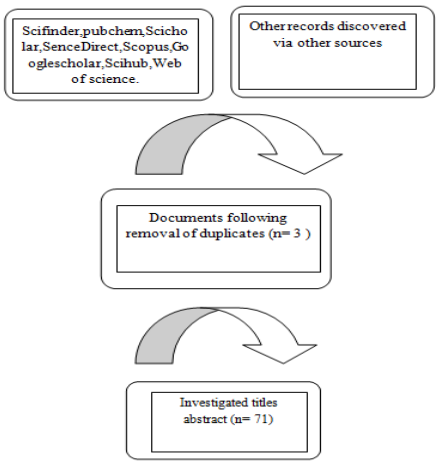


Figure 1: Flow chart of Data extraction

3. Botany [21]

Tradescantia pallida is a perennial herbaceous ornamental, a member of the *Commelinaceae* family. It is commonly distributed in tropical and subtropical regions, east of Mexico. The plant is known for having a strong pointed top, a deep royal purple color with a dusty green tinge, and bright purple leaves and pink to purple flowers in small dense cymose clusters [12]. Research on this species has traced the anatomical and physiological changes in the limbus under the action of light of different intensities. This species has a great capacity for adaptation, can colonize a wide range of environments, and grows very well in bright light and shaded places. The species is also known for the presence of calcium oxalate crystals in the parenchyma of all vegetative organs and flowers, in the form of raphides and tetragonal crystals [13].

3.1 Synonyms[13]

Preferred Scientific Name: *Tradescantia pallida* (Rose) D.R. Hunt, 1975; Preferred Common Name: purple queen; Other Scientific Names: *Setcreasea jaumavensis* Matuda, *Setcreasea lanceolata* Faruqi, Mehra & Celarier, *Setcreasea pallida* Rose, *Setcreasea purpurea* Boom, *Tradescantia purpurea* Boom

3.2 Scientific classification [13]

Domain: Eukaryota
Kingdom: Plantae
Phylum: Streptophyta
Subphylum: Angiospermae
Class: Monocotyledonae
Order: Commelinales
Family: Commelinaceae
Genus: Tradescantia
Species: *Tradescantia pallida*

Figure 2:(a) *Tradescantia pallida* (Purple Heart) (b) Flower

4. Traditional uses

Traditional medicine has been using medicinal herbs for ages because of their well-tolerated benefits, affordability, ease of use, and lack of severe adverse effects. There has been a surge in interest in medicinal plants worldwide in recent years. Because there aren't enough standards and authentication criteria to guarantee the quality and purity of herbal medications, questions have always been raised regarding their proper use. Furthermore, the absence of standards pertaining to the originality of drugs has made adulterations and substitutions in herbal remedies a major issue in recent years [12]. *Tradescantia pallida* is a perennial plant [15] widely distributed in the tropical and subtropical regions [12] of Pakistan, India, Bangladesh and Africa [16] Traditionally, *T. pallida* was thought to enhance blood circulation [12, 17, 18, 19], operate as an anti-inflammatory and anti-toxic supplement [20], and be an antioxidant [12, 16, 17, 18]. In Malaysia, the Ayta communities of Potrac, Pampanga, utilize this herb to heal injured eyes, mainly to prevent sore eyes [12, 16, 17, 20] and purified and cleaned airborne volatile organic compounds. *T. pallida* has been shown to be an effective option for *in situ* mutagenesis testing. Methanol extracts of the leaves show promising antioxidant, anticancer, and antibacterial [4, 12, 21] properties against both gram-positive and gram-negative bacteria [19, 22]. *T. pallida* mediated zinc oxide nanoparticles have been demonstrated to be efficacious against cervical cancer cell lines [17, 23, 12]. Malaysians recommend a decoction of the plant to improve kidney function [21], and it is thought to be beneficial in the treatment of venomous snakebites, leukorrhea, urinary tract infections [21], nephritis, and intestinal inflammation [3]. In various ethnic communities, *Tradescantia pallida* has been used as an antidiabetic ethnopharmacological fraction [16]. In terms of pharmacological benefits, the leaves of *T. pallida* have been used as a tincture and have acted as an anode against rheumatism and joint pain [4]. Anthocyanin from *T. pallida* is used as a natural food color, which may be potentially beneficial for heart patients and cancer prevention [19, 24, 25]. Chloroform extract of *T. pallida* has shown the most promising effect against *Labeo rohita* pathogens [19].

T. pallida is planted as a ground cover or as an ornamental plant [19, 26, 27] in hanging pots for its attractive foliage, traditionally at Maha Sarakham province in Thailand [28], and is highly adaptable, particularly to a shaded environment in Romania [23]. The people of this province believed that the therapeutic properties of *T. pallida* help to relieve dehydration and inflammatory syndrome. The recommended method of preparation is to boil the entire plant in water and then consume the resulting infusion to aid healing. This particular botanical specimen placed in a closed space, such as a room, and thus contributed to air purification and oxygen production at night [28] also renowned for effectively removing volatile organic pollutants from the air [18, 29] and this species is an excellent bioindicator of air pollution levels [4, 30]. *Tradescantia pallida* (Rose) D. R. Hunt var. purpurea Boom is a suitable alternative for genotoxicity testing of air pollutants [31] as it is well adapted and widely cultivated in tropical and subtropical regions [32].

5. Pharmacological activities

5.1 Antidiabetic Activity

The study indicates that niosomes loaded with the extract have a better antidiabetic effect than the crude extract and the standard drug. Chloroform extract of leaves of *T. pallida* helps to prepare phytoniosome, which is remarkable for its effect against alloxan-induced diabetes at a dose of 50 mg/kg. Study also indicates that *in vitro* models like alpha-amylase inhibition assay and non-enzymatic glycosylation of hemoglobin assay help to determine the antidiabetic activities of pure extract and niosomal formulation in the extract [3]. The antidiabetic compounds from *Tradescantia pallida* leaves were isolated using column chromatography. Syringic acid, p-coumaric acid, morin, and catechin isolated from the leaves of *T. pallida* have antidiabetic activity. Alpha-amylase and non-enzymatic glycosylation of hemoglobin protein assays were used to assess the *in vitro* antidiabetic potential of the phenolic compounds [34].

5.2 Antibacterial activity

This study determines the silver nanoparticles by using the aqueous extract of *T. pallida*, which is remarkable for its antibacterial activity. Silver nanoparticles are non-toxic, highly effective against bacteria, and are used as antibiotics [35]. Methanolic extract of *Tradescantia pallida* leaf appeared to have antibacterial activity against methicillin-resistant *Staphylococcus aureus, Bacillus subtilis, Enterococcus faecalis, Micrococcus luteus*, and *Staphylococcus epidermidis* [23]. *Tradescantia pallida* has antibacterial activities against gram-positive and *Staphylococcus* bacteria. *Pseudomonas aeruginosa* is a gram-negative bacterium that can form biofilm. The aqueous extract of *T. pallida* is used to prevent bacterial growth and the formation of biofilm [22]. The MIC for *Pseudomonas aeruginosa* is 64 microgram/ml [1]. Furthermore, the bacterial growth can be inhibited by using polyphenol-rich *T. pallida* extracts [38]. The 10 microgram/ml chloroform extract of *T. pallida* shows antibacterial activity against fish pathogens using well diffusion and disc diffusion assay [10].

5.3 Antioxidant activity

This study shows that the silver nanoparticles were biosynthesized from the $AgNO_3$ precursors using the *T. pallida* aqueous extract. AgNPs inhibited the DPPH free radical scavenging activity with an IC_{50}= 91.87 µg/ml. 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging activity and reducing power assay are performed [1, 36]. *T. pallida* leaf extract shows the highest antioxidant activity for the ethyl acetate fraction (IC_{50}= 14.55±016µg/mL and Abs= 0.613 at 300µg). This Study also investigates that *Tradescantia pallida* methanol extract contains abundant antioxidants and can protect human dermal fibroblasts at the maximum dose of 50µg/ml [40].

5.4 Cytotoxic activity

Hexane extract from *T. pallida* shows cytotoxic activity against tumor cell lines [2]. This study used various types of human cells to determine the cytotoxicity of samples, including non-tumoral fibroblasts and cervical adenocarcinoma (HeLa). The evaluation of cytotoxicity was carried out by the colorimetric assay of the toxicology *in vitro* Kit XTT [1]. Anticancer activity of *T. pallida* leaf extract is also found. The synthetic nanoparticles based on *T. pallida* show cytotoxic activity in HeLa cervical cancer cells at a dose of 1000mg/mL. *T. pallida* extract exhibited good cytotoxicity with an IC_{50} value of 90.59 ± 1.6 µg/mL and a cell viability % of 27.4 ± 1.05 [23].

5.5 Antifungal activity

This study shows the antifungal activity of the Hexane extract from *T. pallida*. Hexane extract shows antifungal activity in *Penicillium digitatum* and *Sclerotinia sclerotiorum* at a dose of 400 µL. It also inhibits 92.6%. Growth in *Rhizopus stolonifer* at the dose of 400 µL [4]. The aqueous natural dye extracted from the leaves of *Tradescantia pallida*. Natural dye is extracted with a concentration range of 0.025-0.85g/ml. Natural dye, such as anthocyanin, is extracted from the leaves of *T. pallida*, which acts as a fungicide probe in *Fusarium solani, Sclerotinia sclerotiorum,* and *Colletotrichum gloeosporioides* fungi [38]. Nanoparticles are synthesized from the leaf of *T. pallida*, which are also used to check the antifungal activity against *Candida albicans* and *Aspergillus niger* [8].

5.6 Hepatoprotective activity

Tradescantia pallida has a high antioxidant content. Research has been performed on its dynamism, analyzing its histopathology, functional, and biochemical parameters to evaluate the hepatoprotective outcome of a *Tradescantia pallida* Ethanol Extract (TPEE). The researcher conducted the study assessing the efficacy of TPEE (50 mg/kg) in chronic induced hepatotoxicity in the Wistar rat model. TPEE administration decreased aspartate aminotransferase (AST), alanine transaminase (ALT), albumin, and alkaline phosphatase (ALP) levels.

The leading characteristic of CCl_4 propensity is fibrogenesis, but transaminase proven beneficial through functional and biochemical observations verified by histopathology analysis. TPEE increases genes involved in antifibrotic and antioxidant actions. These judgments note that TPEE has superior hepatoprotective characteristics equivalent to silymarin, a conventional hepatoprotective chemical [5].

5.7 Larvicidal activity

Recent research has revealed that *Tradescantia pallida* showed larvicidal activity against *Aedes aegypti* larvae [5]. Betim et al.(2019) provided the methodology that was modified for the quantitative degree of larvicidal activity. To assess extract activities, *A. aegypti* eggs were incubated in a BOD oven at 25 + 3 °C and 80 percent relative humidity. The larvicidal activities of Ethyl Acetate Extract (EAE) and Ethanolic Extract (EE) were evaluated at concentrations ranging from 10, 100, and 1000 micrograms per liter. *Tradescantia pallida* is considered as a bioinsecticide [7].

6. Other activities

Dye: This study isolates the anthocyanin from the aqueous extract of *Tradescantia pallida*. Anthocyanin is used as food colorants. Anthocyanin is also used to prevent coronary heart disease and cancer. The purity and identity of the isolated anthocyanin were determined by HPLC using diode array detection. *T. pallida* gives pH-dependent color. It is red at pH three and yellow at pH 8 [25, 38, 39]. *Tradescantia pallida* contains two major anthocyanins, one of which is cyanidin-3,7,3'-triglucoside with three molecules of ferulic acid and an extra terminal glucose unit. The other is similar but without the terminal glucose unit. For these two anthocyanins, *T. pallida* is used as a food colorant [24].

6.1 Multidrug resistance of T. pallida in the human body

According to a recent study, *T. pallida* has an antibiotic effect. Its root and stem extracts have antibacterial properties against vancomycin-resistant Enterococcus. It is isolated and identified that endophytic fungi from *T. pallida* leaves and identify their antagonistic effects on multidrug-resistant human pathogens [19]. It is also determined that *T. pallida* purpurea in chloroform extract inhibits the growth of fish pathogens [10]. Aqueous *T. pallida* extracts inhibit bacterial growth [19].

6.2 Pesticidal properties

In an investigation, researchers found that the *Tradescantia pallida* aqueous extract obtained through the infusion method (ETPI) yielded the most favorable outcomes, particularly in the context of overall insect development specially the mature period, dropping the number of individuals in the following generation, and so minimizing harm in the various *Brassicaceae* cultures grown organically [49]. The biological landmarks of insects, including mortality [40, 41, 42], deviations in food [43, 44] or oviposition [44, 45], favoritism, malformations, and morphological and physiological metamorphosis of *P. xylostella* [15, 41, 46, 47], are switched according to studies involving *T. pallida* plant extracts with insecticidal properties.

7. Environmental Effect

7.1 Effect on soil

The contaminants are deposited on the soil periphery when the soil becomes accumulated with organic materials, trace elements, and hazardous metals. Many metals, including iron, chromium, zinc, cadmium, arsenic, mercury, and copper, are known to degrade soil quality seriously and negatively impact human health and the health of other creatures that come into contact with them [48]. Heavy metals persist in the environment and may not decompose through chemical oxidation due to their non-biodegradability [49]. A collection of ecological

techniques known as phytoremediation uses plants to encourage the breakdown and immobilization of contaminants in order to remove them from the environment *in situ*. Through phytoextraction, which assembles pollutants like heavy metals from the environment into plant tissues, plants can directly influence the amounts of contaminants [50, 51]. With minimal impact on the surrounding environment, phytoremediation is an affordable remediation method for eliminating pollutants from polluted soils and streams at the site level, primarily heavy metals and organic compounds. Additionally, it lowers the price of disposing of hazardous waste in an off-site storage facility or landfill [52]. *T. pallida* is well known for its capacity to efficiently remove airborne volatile organic pollutants [53]. *T. pallida* can clean the air and inedible plants, develop quickly, and coexist in all seasons. The plants that can perform the phytoremediation process employ several processes, including: 1) tolerance mechanisms based on their capacity to withstand elevated concentrations of heavy metals that generally hinder or kill plants. 2) Detoxification mechanisms through respiration and photosynthesis contribute to preserving low levels of heavy metals in the cytoplasm, potentially serving as a detoxifying mechanism [54]. Current finding shows that different fertilizers have demonstrated varying capacities to remove distinct heavy metals from polluted soil when used to cultivate the violet plant *T. pallida*. The investigated soil's nickel (Ni) concentration was higher than the highest amount allowed by the WHO. When commercial fertilizer was applied, followed by cow dung and bird manure treatments, *T. pallida* demonstrated a greater capacity to extract nickel from the contaminated soil [55].

7.2 Effect on air

T. pallida is an effective bioindicator for air pollution biomonitoring in urban environments. As confirmed by neutron activation analysis, its leaves accumulated significant levels of trace elements like Ba, Cr, Fe, and Sb [56]. *T. pallida* has an effect on micronucleus frequency from vehicular traffic, which has an environmental effect and causes cardiovascular disease [57]. As it is a bioindicator Species, it is used in monitoring atmospheric pollution in forensic investigations [58]. *T. pallida* is used to detect and measure DNA damage by air pollution, specifically in vehicular traffic areas, to identify the genetic damage of the plant [59]. Pollution is detected by instrumental neutron activation analysis (INAA), which measures pollutants and is also seen as a cost-effective air quality monitoring in various regions [56]. There is a computer vision model for analyzing *T. clone* 4430 stamen hair cells sensitive to environmental stressors like air pollution [60]. *T. pallida* has an effect on micronucleus frequency from vehicular traffic, which has an environmental effect and causes cardiovascular disease [61]. Due to its properties, *T. pallida* can be an essential tool for forensic experiments to identify various environmental crimes [62].

7.3 Effect on water

T. pallida var. purpurea cuttings with flower buds are utilized in bioassays to diagnose genotoxic effects of water [63]. Biomimetic superhydrophobic materials are innovative solutions that mimic nature's ability to repel water, inspired by structures like those of lotus leaves that cause droplets to bead and roll off. In water harvesting, these materials enhance moisture capture from air and rain by preventing water from sticking to surfaces, allowing it to flow efficiently into storage systems. This approach maximizes water collection and minimizes waste [64]. *Tradescantia pallida* is a plant that grows well in dry areas. It captures moisture from the air using its special leaves, which have tiny hairs and grooves. This unique ability has inspired scientists to create surfaces that mimic these features for smart water-harvesting systems. Using these designs from nature, we can develop new technologies that help solve water scarcity and improve access to water in areas affected by drought [65]. Researchers found a crucial link between flooding intercellular spaces and stomatal closure in *Tradescantia pallida (T. pallida)*. Injecting water into these spaces caused rapid stomatal closure not only in *T. pallida* but also in other plant species. This response is primarily due to the dilution of potassium ions in guard cells, which are essential for stomatal regulation. A vapor-phase signal from the mesophyll may also play a role, highlighting the complexity of plant responses to excess water. This research underlines the need to understand plant physiology in managing water-related challenges [66]. Degradation of water quality at all sites, with exposure to effluents causing genotoxic effects in *Tradescantia pallida* [67]. These findings underscore the

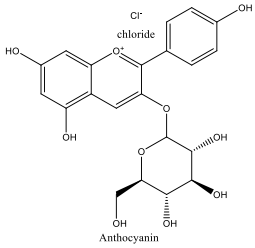
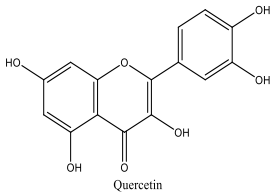
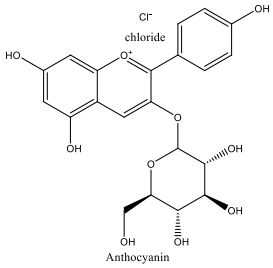
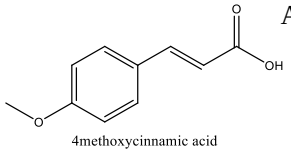
sensitivity of the Trad-MCN bioassay and its vital role in water quality monitoring, recommending its integration with standard physicochemical analyses for comprehensive evaluations [68].

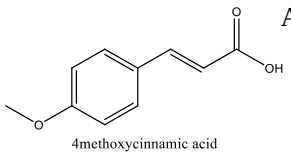
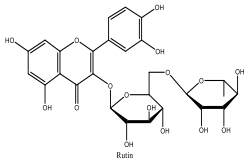
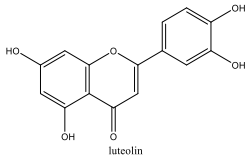
Table 1: Pharmacological activities *of Tradescantia pallida.*

SL. no.	Pharmacological Activity	Extract	Doses checked	Experimental Methods/ Models	Ref.
1	Antifungal	Hexane	400 µl	Disc-diffusion method in fungi of *P. digitatum, S. sclerotiorum, R. stolonifer*	[2]
2	Cytotoxic	Hexane	31.25-1000 µg/ml	Colorimetric assay in a human tumor cell line.	[2]
3	Antidiabetic	Chloroform	50 mg/kg	Alloxan induced diabetes in mice.	[3]
4	Antibacterial	AgNPs using aqueous extract	25-100 µg/ml	FTIr method, both gram-positive and gram-negative bacteria.	[4]
5	Antioxidant	AgNPs using aqueous extract	50 µg/ml	DPPH method in *P. aeruginosa.*	[1, 4]
6	Hepatoprotective activity	Ethanol	50 mg\kg	CCl_4 induced liver damage in Wistar rats	[5]
7	Larvicidal activity	Ethyl Acetate, Ethanol	10, 100, 1000 µg/L	Docking study in *Aedes aegypti* larvae	[5, 6]
8	Cytotoxic Activity	Ethyl acetate, ethanol	31.25-1000 (µg/L) concentration	*In vitro* cytotoxic activity to control the dengue mosquito	[6]
9	Antibacterial	Methanolic leaf extract	0.02-10 mg\ml	Antioxidant Content, Antioxidant Activity, and Antibacterial Activity of Five plants from the *Commelinaceae* family, 8 species of Gram-positive (Methicillin-Resistant *Staphylococcus aureus, Proteus vulgaris, Bacillus cereus, Aeromonas hydrophila, Bacillus subtilis, Enterococcus fascalis, Micrococcus luteus, Staphylococcus epidermis.*	[7]

10	Antifungal activity	*Tradescantia pallida* plant extract Biosynthesized *Tradescantia pallida* silver nanoparticles	40 µL, 5mg/ml	Agar well diffusion method in fungi	[1]

Table 2: Compounds isolated from *Tradescantia pallida*

SL. No.	Purified compounds	Parts of the plant	Model used	Doses checked	Pharmacologi--cal activity	Conclusion	Ref.
1	 Anthocyanin	Leave		0.025 - 0.85 g/ml	Fungicidal	Active against the tested strain	[8]
2	 Quercetin	Whole plant	*In vitro*	10, 100, 1000 µg/L	larvicidal	active against the tested strain	[5]
3	 Anthocyanin	Whole plant	*In vitro*	2.99 mg/ml	antioxidant	*In vitro* studies have shown that anthocyanin possess antioxidant activity.	[69]
4	 4methoxycinnamic acid	Aerial part	*In vitro*	400 µL	Antifungal activity	active against the tested strain	[10]

5	 4methoxycinnamic acid	Aerial part	*In vitro*	31.25-1000 µg/mL	Cytotoxic activity	Active against the tested strain	[42]
6	 Rutin	Whole plant	*In vivo*		Insecticidal	Active against *P. xylostella* larvae	[69, 71]
7	 luteolin	Whole plant	*In vivo*		Insecticidal	Active against *P. xylostella* larvae	[17]

8. Phytochemistry

Tradescantia pallida contains phenolic compounds. The chloroform extract of *T. pallida* leaves is rich in polyphenols, and the amounts of flavonoids and polysaccharides are lower. *T. Pallida* extract also contains tannins, alkaloids, and saponins [33]. These compounds of *T. pallida* extract reveal a great degree of effectiveness in antioxidant, antibacterial, antitumor, cytotoxic, and *in vivo* analgesic activities. The silver nanoparticles from the *T. pallida* have antibacterial and antioxidant activity [4]. Silver nanoparticles are obtained by using the aqueous extract of *T. pallida.* The colorimetric method can determine total flavonoid content, and quercetin can be used as a reference for determining the flavonoid [33]. The phenolic content of *T. pallida* extract can be determined by the Folin-Ciocalteu method. *T. pallida* extract is also a rich source of anthocyanins, which are naturally colored compounds. They are obtained by a pH-differential method [16].

9. Conclusion

Tradescantia pallida, or the Purple Queen, is remarkable for its aesthetic appeal and significant applications in medicine, ecology, and industry. This plant is rich in bioactive compounds that provide potent antioxidant, antimicrobial, and antidiabetic benefits, reinforcing its traditional medicinal use. Moreover, *Tradescantia pallida* plays a vital role in phytoremediation and enhances indoor air quality by filtering pollutants, highlighting its importance in sustainable practices. To fully realize the potential of *Tradescantia pallida*, focused research is essential. Bridging traditional knowledge with modern science will drive innovative applications in healthcare, environmental management, and industry, maximizing the benefits of this extraordinary plant.

Author Contributions: The authors confirm contribution to the paper as follows: study conception and design: PRD and DN. Methodology: MSR and TB; data analysis and interpretation of results: SAE, NAS, RS, SSJ. Supervision: PRD and DN Draft manuscript preparation: SAE, NAS, RS, SSJ. All authors reviewed and approved the final version of the manuscript. All authors have read and agreed to the published version of the

manuscript.

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors**.**

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