Indian J. Applied & Pure Bio. Vol. 40(1), 228-243 (2025). **ISSN: 0970-2091**
A Web of Science Journal

Phytochemistry and pharmacological potential of *Monstera deliciosa* : A comprehensive review

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Abstract

Present review explores the phytochemical composition and diverse pharmacological activities of Monstera plants, particularly *Monstera deliciosa*. Phytochemical analyses have identified various bioactive compounds in different plant parts, including alkaloids, flavonoids, phenolic compounds, terpenoids, and saponins. The review highlights the antibacterial properties of Monstera extracts against pathogenic bacteria, with proposed mechanisms involving cell membrane disruption, enzyme inhibition, and oxidative stress induction. Additionally, the antioxidant potential of the plant is discussed, attributed to its ability to scavenge free radicals and mitigate oxidative stress. Cytotoxic activities against cancer cell lines are also examined, suggesting potential anticancer applications. Other reported pharmacological activities, such as anti-inflammatory, immunomodulatory, and insecticidal effects, are also explored. This review underscores the significant medicinal value of Monstera plants and the need for further research to exploit their therapeutic potential in developing natural product-based treatments.

Key words : *Monstera,* Phytochemistry, Pharmacological activities, Medicinal plants, Bioactive compounds etc.

Kumari Kavita is thankful to University Grants Commission (UGC), New Delhi, India for research fellowship in terms of Junior Research Fellowship (vide Ref No. 774/ (CSIR-UGC NET Dec 2018) dt 11 Jul 2019.

In many traditional medical systems, herbal and plant remedies have been utilized for generations for both healing and preventing disease. These plants' therapeutic qualities result from a wide variety of bioactive substances they contain, such as flavonoids, alkaloids, terpenoids, and phenolic compounds that have important medical applications. The phytochemicals present in historical plants not only protect and develop the plant species itself but also have the potential to treat various diseases in other organisms, including humans. Nature has numerous such medicinal plants identified or yet to be identified[15]. In addition to having a long history in cultural practices, using medicinal plants for medical purposes is also backed by research showing possible advantages. The healthcare industry is always looking for complementary and alternative treatments to traditional medicine, focusing on organic products made from medicinal plants. This interest is motivated by several factors, including the increased popularity of natural medicines, the demand for new, potent therapeutic agents, and the growing concern about the adverse effects and drug resistance brought on by synthetic pharmaceuticals.

The potential of medicinal plants, especially Monstera species, in numerous healthcare applications has attracted interest. These plants' bioactive substances have various pharmacological effects, including antibacterial, antioxidant, anti-inflammatory, cancer prevention, and immunomodulatory ones. Due to these characteristics, medicinal plants hold great promise as a source of potential new medication candidates and complementary therapies for various illnesses and medical conditions[2].

This review intends to emphasize Monstera plants' importance in the medical field by describing the phytochemical makeup and pharmacological potential of Monstera plants. The creation of new medications, nutraceuticals, and plant-based treatments can be aided by an understanding of these plants' medicinal qualities and potential mechanisms of action. In addition, the study of plants with medicinal properties like Monstera opens the door to environmentally friendly methods of healthcare delivery because these plants are frequently grown and collected.

Different parts of the plant :

Monstera plants (*Monstera* spp.) are well known for their pleasing appearance and have become very popular as decorative houseplants. These plants are indigenous to the tropics of South and Central America and are members of the Araceae family. The tropical jungles of southern Mexico and Panama are home to this species of flowering plant. About fifty different kinds of plants with flowers that are native to the tropics of the North American continent and are part of the arum family make up the genus *Monstera*[17].

The *Monstera* plant was initially described in 1850 by Carl Sigismund Kunth, a botanist, according to its full scientific name, *Monstera deliciosa* Liebm. The word "deliciosa" (Latin for "delicious") alludes to the plant's edible fruit.

Leaves :

The *Monstera deliciosa* plant is easily recognizable by its distinctive foliage. The leaves are large, heart-shaped, and deeply

lobed, with perforations or openings known as fenestrations. These fenestrations give the leaves a unique, Swiss cheese-like appearance, earning the plant its common name. These leaves are frequently used as decorative elements to add a tropical and exotic flair to indoor and outdoor spaces. The plant is also commonly referred to as the "hurricane plant" or "Mexican breadfruit." It can grow up to 20 meters (66 feet) tall and has aerial roots. Indoors, it rarely flowers, but when it does, it produces edible fruit with a fruit salad-like flavor.

Aerial roots :

The *Monstera deliciosa*, popularly known as the Swiss cheese plant, is renowned for its striking foliage and unique aerial roots. These roots have several notable characteristics:

1. *Anchorage :* The aerial roots help anchor the *Monstera deliciosa* to trees or other structures in its natural habitat, providing stability, especially during windy or stormy conditions.

2. *Nutrient absorption:* While the primary function of roots is to absorb water and nutrients from the soil, aerial roots can also absorb moisture and nutrients from the air, which can be beneficial in nutrient-scarce environments.

3. *Epiphytic growth adaptation :* As an epiphytic plant, *Monstera deliciosa* typically grows on other plants or structures without being parasitic. Aerial roots play a crucial role in this adaptation by allowing the plant to obtain water and nutrients from the air and organic matter accumulating around them.

4. *Climbing support :* In its natural habitat, *Monstera deliciosa* uses its aerial roots to climb trees or other vertical surfaces, attaching to surfaces and providing support as the plant grows upward towards sunlight.

5. *Propagation :* Aerial roots also contribute to the plant's ability to propagate. When in contact with soil, they can take root and give rise to a new plant, aiding in the plant's spread and reproduction.

Stem :

Monstera deliciosa stems are sturdy, protruding, and climbing in nature. They have aerial roots that help the plant cling to its supporting structures. *Monstera deliciosa* is a popular choice for those seeking a dramatic vertical accent in gardens or indoor settings, as the stems can grow to significant lengths. The stems are occasionally also used in crafts to build trellises or decorative structures. Like other parts of the plant, the stem of the *Monstera deliciosa* has several properties that contribute to its overall growth and function. Some stems may develop fenestrations, or splits and holes, which are believed to aid in capturing more light and increasing stability as the plant climbs.

Monstera deliciosa stems can also be used for propagation. Cuttings taken from healthy stems can be rooted in soil or water to grow new plants, making them a popular method for propagating this species. The stem plays a crucial role in providing support, transporting water and nutrients, contributing to photosynthesis, aiding in climbing, and

Figure 1. *Monstera deliciosa* showing plant parts (Leaves, Stem, Arial Roots, Inflorescence and fruits)

serving as a means of propagation, all of which are essential for the plant's growth and development.

Fruits :

Monstera deliciosa's fruit is one of the plant's most intriguing features and the source of its alternate popular name, "delicious monster." The fruit is a substantial, cylindrical structure made up of numerous distinct hexagonal scales. It starts out green and solid, but as it ripens, the scales turn yellow and take on a sweet, tropical flavor. The fruit is edible when ripe and is widely coveted for its distinctive taste. It is important to note that the plant's unripe fruit and other parts, such as the leaves, can be poisonous if consumed and should be avoided.

The Araceae family has garnered interest for its traditional uses since antiquity. This family of species is utilized as a phytomedicine because of its antioxidant, hepatoprotective, antimicrobial, and many nutritional and medicinal properties. Many societies in Mexico and Peru have used the roots as a source of material for rope and basket weaving. The roots are additionally utilized in Martinique to cure snakebites and have been used for medicinal purposes by Mexicans to ease the discomfort associated with arthritis. While

portions of the Monstera plant are used in China to cure high temperatures, infections, bruises, coughs, and bruises, Brazilians warm the leaves and crush them to cauterize wounds[25].

Phytochemistry of Monstera plant :

Monstera, scientifically known as *Monstera deliciosa*, is a popular tropical plant known for its large, glossy green leaves and unique, Swiss cheese-like leaf patterns. While primarily appreciated as an ornamental plant, Monstera has also drawn attention from a phytochemical perspective due to its potential medicinal and nutritional properties. In order to determine the bioactive substances present in different parts of Monstera plants, including *Monstera deliciosa*, phytochemical analysis has been performed. Numerous phytochemical components, such as flavonoids, alkaloids, phenolic compounds, terpenoids, and glycosides, have been identified through these studies[13].

An analysis in the Philippines recorded the nutrient composition of the ceriman fruit per 100 g of the edible portion as follows[12]: 737 kcal/kg, 77.88% moisture, 1.81% protein, 0.2% fat, 16.19% sugar, 0.57% fiber, and 0.85% ash. Additionally, the pulp is rich in potassium and vitamin C. During the ripening process, *Monstera deliciosa* undergoes a significant climacteric phase with a substantial increase in ethylene production. The ripe fruit contains 19.1% soluble solids, 7-8 meq/100 g titratable acidity, and 0.41% oxalic acid, the latter contributing to its acridity. This acridity is due to oxalic acid raphides and associated proteins in the developing fruit, floral remnants, and other plant parts. Researchers have deemed the ripe fruit juice safe for human consumption concerning saponin, hydrocyanic acid, and oxalic acid levels[19].

Approximately 400 volatile components responsible for the fruit's characteristic flavor were identified, mainly consisting of esters and lactones[18]. Monstera contains various phytochemicals, including alkaloids, flavonoids, phenolics, saponins, tannins, and terpenoids. These compounds contribute to the plant's biological activities and potential health benefits. Details of phytochemicals found in different parts of the plant are given in Table-1.

Table-1. Phytochemicals of *Monstera deliciosa*

Sr. No.	Name of Compound	Plant Part	References
1.	Phenolics, Flavonoids, Alkaloids, Anthraquinones, Polyphenols, Carbohydrates, Steroids and Cardiac glycosides and Tannins	Stem	[22],[1],[7],[16],[11],[26],[8]
	Alkaloids, Saponins, Phenols and Flavonoids	Leaves	
	Anthraquinones, Polyphenols, Anthocyanins, Tannins, Phenolic compound, Steroids, Saponins, Esters, terpenoids, Carbohydrate, Protein, Fat, Flavonoids, Ethyl butanoate, Limonene and Linalool	Fruit	
	Carbohydrates (lignin and suberin), Flavonoids	Roots	

Alkaloids :

Some alkaloids have been identified in Monstera species, although the specific types and their concentrations may vary. Alkaloids are known for their diverse pharmacological effects and are often associated with medicinal plants. These substances frequently exhibit notable pharmacological effects and have been carefully examined for potential medicinal uses. Alkaloids are present in Monstera plants, but their precise composition and pharmacological characteristics can vary[22].

Rutin, tannins, and glycosides are a few compounds that have been identified in several Monstera species. Polyphenolic substances called tannins are well-known for being astringent and are thought to have antibacterial and anti-inflammatory properties. Another class of compounds identified in Monstera plants are glycosides. These substances are composed of two non-sugar moieties joined by a sugar molecule. Glycosides have a variety of pharmacological effects and are frequently linked to anti-inflammatory, antimicrobial, and anticancer characteristics.

Flavonoids : Flavonoids are a class of polyphenolic compounds with antioxidant properties. These compounds contribute to the plant's color, flavour and potential health benefits. Flavonoids in *Monstera* may contribute to its antioxidant activity and protective effects against oxidative stress. Monstera plants contain flavonoids, such as quercetin, kaempferol, and rutin, which have diverse biological activities and potential health benefits. These flavonoids are identified through phytochemical analyses and play a crucial role in the plant's defense mechanisms and interactions with the environment. Quercetin is a potent antioxidant, protecting cells from oxidative stress and reducing inflammation. Kaempferol, another flavonoid, has antioxidant, anti-inflammatory, and anticancer properties, modulating signaling pathways involved in inflammation and cancer development. Rutin, a flavonoid glycoside, is known for its antioxidant activity and potential vascular protective effects. These flavonoids contribute to the plant's pharmacological activities and contribute to its overall health benefits.

Phenolics : Phenolic compounds, including phenolic acids and phenolic glycosides, are abundant in many plant species, including Monstera. These compounds have antioxidant, anti-inflammatory, and antimicrobial properties, which may contribute to the plant's potential health benefits.

1. ***Saponins*** *:* Saponins are glycosides with foaming properties and are often associated with plants' medicinal properties. They have been found in various parts of Monstera plants and may possess pharmacological activities, such as antimicrobial and antifungal effects.
2. ***Tannins*** *:* Tannins are polyphenolic compounds known for their astringent taste and ability to precipitate proteins. They have been identified in Monstera and may contribute to its potential medicinal properties, including antioxidant and anti-inflammatory effects.

Terpenoids *:* Terpenoids are a diverse class of compounds with various biological activities. Monstera plants contain a diverse class of terpenoids, including Limonene,

β-Sitosterol, and Campesterol. Limonene, a Citrus-like aroma, has antimicrobial, anti-inflammatory, and antioxidant properties, and has shown potential as an anticancer agent. β-Sitosterol, a phytosterol belonging to the terpenoid family, exhibits anti-inflammatory, antioxidant, and immunomodulatory activities, and has been studied for its potential role in reducing cholesterol levels and anticancer effects. These terpenoids contribute to the overall phytochemical profile of Monstera plants and are responsible for their observed pharmacological activities.

While research on the medicinal properties of Monstera is still in its early stages, the plant's phytochemical constituents suggest potential health benefits, including antioxidant, anti-inflammatory, antimicrobial, and possibly even anticancer effects. However, further studies are needed to fully understand the mechanisms of action and therapeutic potential of Monstera phytochemicals.

Overall, the phytochemistry of the Monstera plant underscores its potential as not just a decorative houseplant but also as a source of bioactive compounds with possible health-promoting properties.

Pharmacological Activities of Monstera plant :

The pharmacological activity of Monstera plants are influenced by their unique phytochemical makeup. The bioactivities of various plant components have been the subject of several research, showing their potential medicinal uses. Details of phramacological activities reported in different

Table-2. Pharmacological Activities of *Monstera deliciosa*

Sr. No.	Plant Part	Extract	Biological Activity	Refer-ences
1.	Fruits and Roots, Stem	Ethanolic extract, Hexane, Chloroform, Ethyl acetate and Methanol extracts	Antibacterial Activity	[8,22–24]
2.	Stem, Fruit and Leaves	Hexane, Chloroform, Ethyl acetate, Ethanol and Methanol extracts	Antioxidant activities	[1,5,7,20,22]
3.	Leaves	Methanol extract	Anticancer activity	[21]
4.	Whole plant	Ethanolic extract	Antidiabetic Activity	[6,10]
6.	Leaves, Whole Plant, Rhizome, Stem	Ethyl acetate extract, DMSO extract, Ethyl acetate extractMethanolic extract	Cytoxicity activity	[4,9]
7.	Stem and Leaves	Methanolic extract	Insecticidal Activity	[28]

parts of the plants are given in table-2.

Antimicrobial :

The *Monstera* plant's antibacterial activity is mediated by a complicated process involving a number of variables and bioactive substances. complex process involving various variables and bioactive substances. Although the precise mechanism of Monstera's antimicrobial effects is not fully understood, several possibilities have been proposed based on current scientific data (Figure-2).

One proposed mechanism of Monstera's antibacterial effect is the presence of bioactive substances such as alkaloids, flavonoids, tannins, saponins, and phenolic compounds. These substances have been found in various parts of Monstera plants and are known to have antibacterial effects by interfering with microbial viability and growth through various methods.

Firstly, it is hypothesized that the bioactive components in Monstera may work against microbes by rupturing their cell walls. These substances may interact with the lipid components of the microbial cell membrane, causing it to rupture and allowing the cell contents to leak out. This disruption compromises the integrity and functionality of the microbial cell, inhibiting its development and survival.

Interfering with microbial enzymes and cellular functions is another suggested way. Certain bioactive substances found in Monstera may stop certain enzymes from performing crucial cellular functions or microbial metabolism. By concentrating on these essential elements, the bioactive substances exert their antimicrobial actions by preventing bacteria growth and survival.

Another suggested mechanism is interfering with microbial enzymes and cellular functions. Certain bioactive substances found in Monstera may inhibit specific enzymes from performing essential cellular functions or microbial metabolism, thereby preventing bacterial growth and survival.

Additionally, Monstera's ability to induce oxidative stress in microbial cells may contribute to its antibacterial activity. Reactive oxygen species (ROS) produced by the bioactive substances in Monstera have antioxidant capabilities but can also accumulate and cause oxidative damage to biological components such as proteins, lipids, and DNA, hindering microbial survival and growth.

It is important to note that the specific bacterial species or strains being targeted may affect the antimicrobial action of Monstera. Different bacteria may respond differently to the bioactive substances found in Monstera, depending on their unique biochemical and physiological traits. Savitsky *et al.,*[23] investigated the dynamics of the seasonal activity of exometabolites for the lianas from the following families: Araliaceae — *Hedera helix* L. and *Schefflera octophylla* (Lour.) Harms Araceae — *Epipremnum aureum* G.S. Bunting, *Monstera deliciosa* Liebm. var. borsigiana H. The antibacterial activity of intact plants was evaluated by exposing inoculated microbial test cultures of *Staphylococcus epidermidis, E. coli*, and *Candida albicans*, among others, to plant volatile emissions in Petri plates. The antibacterial action was compared to the reference using a scale of phytoncide activity. The antibacterial activity of intact plant leaves' exometabolites was

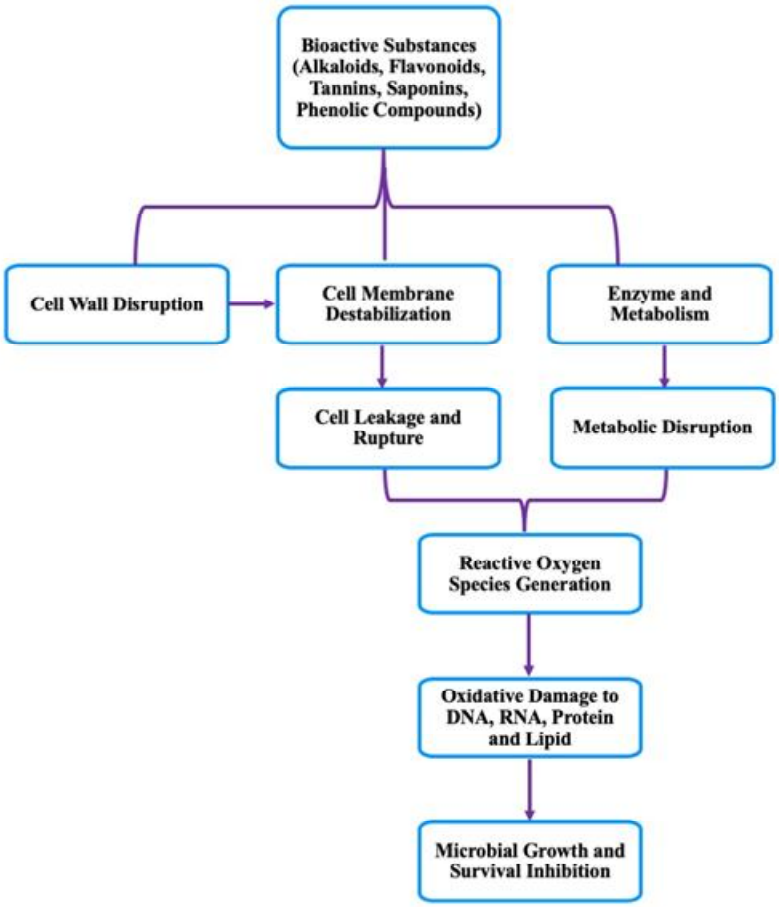

Figure 2. Line diagram illustrates the proposed mechanisms by which bioactive substances in *Monstera* plants interact with microbial cells to exert their antibacterial effects. The diagram shows three main pathways: 1) Cell wall and membrane disruption leading to cell leakage and rupture, 2) Inhibition of enzymes and metabolism, and 3) Production of reactive oxygen species leading to oxidative damage. All three pathways ultimately contribute to the inhibition of microbial growth and survival.

found to be species- and season-specific. All of the examined plants' *S. epidermidis* resistance shown a little seasonal fluctuation. *H. helix*, var. borsigiana, *M. deliciosa*, and *S. octophylla* all shown potent anti-*E coli* action, and *E. aureum* and *S. octophylla* both exhibited antifungal activities.

Throughout the rapid development of the summer and the autumn and winter, *S. epidermidis* was the focus of intensive antifungal and antiviral therapy. A large amount of antifungal and antibacterial activity was directed against *S. epidermidis*. These test results show that plants have antibacterial activity against tested objects depending on the

stage of seasonal development.

Similarly, Rao *et al.*[22], explored the phytochemical components, antioxidant, and antibacterial properties of *Monstera deliciosa* stem extracts. The plant stem extracts from *Monstera deliciosa* are highly concentrated in phenolics, flavonoids, alkaloids, and tannins. Different phytochemicals, potential antibacterial, and antioxidant activity are present in this plant's preparations. Diffusion agar well studies using hexene extract demonstrated antibacterial and antioxidant activities against Gram-positive and Gram-negative microorganisms. Surprisingly ethyl acetate extract demonstrated a greater zone of inhibition against *Serratia marcescens* when compared to regular streptomycin.

At concentrations of 100 mg/ml and 200 mg/ml, hexane, chloroform, ethyl acetate, and methanol extracts demonstrated lower efficacy in neutralizing free radicals compared to the standard ascorbic acid, whereas the latter exhibited greater activity. These findings suggest that this plant possesses medicinal importance due to its diverse array of phytochemicals.

Stephen *et al.*[27] presented a fascinating investigation into the antibacterial activity of extracts taken from three decorative plants and the endophytic fungi associated with them. The authors examined the morpho-cultural characteristics of the endophytes, assessed their antibacterial capacities, and compared them with those of the host plant extracts.

The thorough technique employed by the researchers is one of the study's advantages. Endophytic fungi from various plant parts, including fallen leaves, roots, and fruits, were isolated, allowing for the investigation of a wide variety of possible antibacterial substances. The authors assessed antibacterial activities using both agar diffusion and broth microdilution methods, resulting in a comprehensive evaluation of inhibitory effects against various bacterial species.

The results revealed that all three plants studied exhibited myco-endophytes with relatively high inhibitory effects on a significant number of microbial strains in solid media, suggesting that they may produce compounds in the environment that limit bacterial growth. The extracted endophytic fungus extracts and plant extracts from broth culture both exhibited less prominent activities compared to those of the host plants, which were much more apparent. The antibacterial activity of endophytic fungi found in *Sansevieria trifasciata* leaves, *M. deliciosa* fruits, *C. fruticosa* roots, and *M. deliciosa* was not correlated with the properties of the host plant species.

Monstera deliciosa (Ceriman plant) exhibits promising antibacterial activity due to the presence of various secondary metabolites like tannins, steroids, saponins, flavonoids, and alkaloids that have been reported to be effective against bacteria such as *Bacillus megaterium*, *Streptococcus mutans*, *Staphylococcus aureus*, *Salmonella enterica*, *Escherichia coli*, and *Serratia marcescens*. Additionally, it contains volatile components including 1,6-cyclodecadiene, naphthalene, limonene, 6,10,14-trimethyl-2-pentadecanone, 1-methyl-5-methylene-8-(1-methylethyl)-, and 2-furanmethanol, which possess antimicrobial, antibacterial, larvicidal, and antiviral properties. Considering these potent bioactive compounds and the successful development of hydrogel

formulations from related plant families like Taro Leaves (Colocasia esculenta (L.) Schott), the literature review suggests that *Monstera deliciosa* could be a promising candidate for developing a 3-in-1 hydrogel spray preparation. Hydrogel spray formulations offer advantages such as low microbial contamination, prolonged contact time with the skin, reduced irritation, adjustable dosage and spray form, and practical application, making them a suitable choice for topical antimicrobial preparations[3].

Anti-oxidant Activity :

Mechanism of Monstera plants as anti-oxidant activity :

The mechanism underlying the antioxidant action (Figure 3) of the Monstera plant is believed to be its ability to neutralize free radicals and prevent oxidative stress. Free radicals, such as reactive oxygen species (ROS), are reactive chemicals that can damage cellular components like proteins, lipids, and DNA, leading to various diseases and the aging process. Antioxidants play a crucial role in combating these damaging effects by neutralizing or inhibiting the formation of free radicals. *Monstera deliciosa* contains bioactive substances, including flavonoids, phenolic compounds, and other phytochemicals, which contribute to its antioxidant activity. Phenolic compounds, in particular, are known for their potent antioxidant capabilities. These substances contain hydroxyl groups ($^{-}$OH) that donate hydrogen atoms to free radicals, thereby stabilizing them and halting the progression of oxidative damage.

The antioxidant properties of *Monstera deliciosa* stem from its ability to scavenge various types of free radicals. In the study reported in the publication, in vitro experiments utilizing radicals such as 1,1-diphenyl-2-picrylhydrazil radical (DPPH), nitric oxide, superoxide anions, and hydroxyl radicals were conducted to assess antioxidant activity. The concentration of the extract required to scavenge 50% of the free radicals is represented by the IC_{50} values obtained from these experiments. A decrease in IC_{50} values indicates a higher level of antioxidant activity[20].

The ability of *Monstera deliciosa* extract to scavenge DPPH radicals suggests its capability to contribute hydrogen atoms for neutralizing this radical species. Moreover, its capacity to scavenge hydroxyl radicals, superoxide anions, and nitric oxide indicates its effectiveness in mitigating the adverse effects of these reactive species. By neutralizing free radicals, the extract helps to lower the risk of oxidative damage and maintains equilibrium between cellular oxidative stress and the antioxidant defense system in cells[14].

In a investigation conducted by Kumar[7], the phytochemical composition and antioxidant properties of different solvent extracts obtained from the fruit kernels of *Monstera deliciosa* Liebm. were examined. The study included screening for phytochemicals, total phenolic, tannin, and flavonoid content, as well as in vitro antioxidant properties of the fruit kernel extracts. Standard protocols, including those for tannins, steroids, alkaloids, sugars, flavonoids, and saponins, were followed.

Antioxidant activity was assessed using the DPPH method. TLC analysis of the

ethanolic extract led to the isolation of two active compounds, both demonstrating high antioxidant properties. The results of the study suggest the medicinal importance of *Monstera deliciosa* due to its antioxidant properties, which are associated with potential health benefits and the prevention of oxidative stress-related diseases. The high antioxidant activity observed in the isolated compounds indicates that *Monstera deliciosa* fruit kernels could serve as a valuable natural source of antioxidants.

Pal *et al*.[5] investigated the antioxidant properties and total phenolic content of the methanol extract of *Monstera deliciosa*. The study aimed to assess the extract's ability to scavenge free radicals using various conventional in vitro techniques, including DPPH, nitric oxide, superoxide anions, and hydroxyl radicals. Additionally, the researchers estimated the amount of phenol in the methanol extract.

The study reveals that the methanol extract of *Monstera deliciosa* exhibits dose-dependent antioxidant activity. The extract's IC_{50} values indicate its effectiveness in

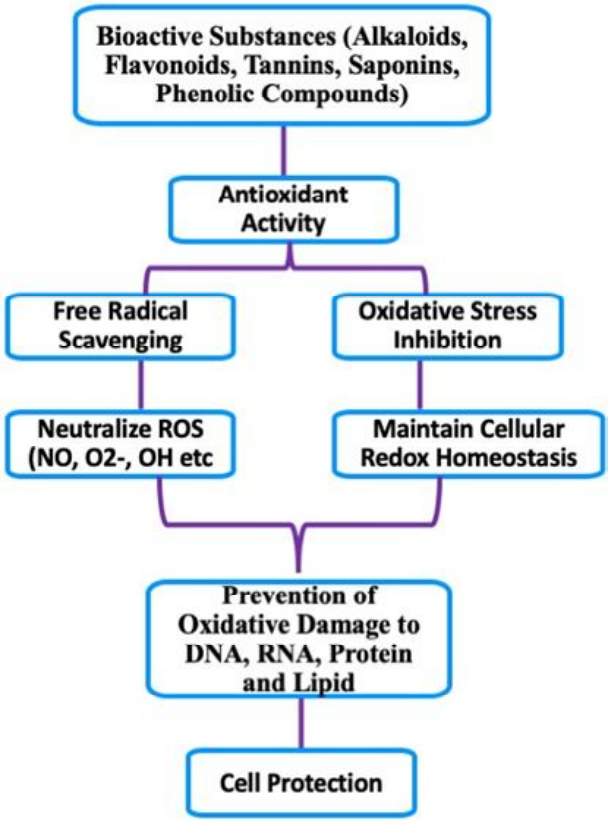

Figure 3: Line diagram depicting the antioxidant activity mechanism of Monstera plants. The diagram shows two main pathways: 1) Free Radical Scavenging, 2) Oxidative Stress inhibition. Both the pathways ultimately contribute to the cell protection.

scavenging free radicals, showing significant antioxidant capacity compared to the standard (ascorbic acid) based on the IC_{50} concentrations of the methanol extract.

The study's strength lies in its use of various in vitro techniques to measure antioxidant activity, providing a comprehensive assessment of the extract's effectiveness. Additionally, the evaluation of the total phenolic content offers further insight into the potential bioactive chemicals responsible for the observed antioxidant activity.

Zhu *et al.*[29] offer valuable insights into the response of *M. deliciosa* Liebm, a plant species, to salt stress induced by different concentrations of NaCl. The study conducted a pot experiment to investigate the impact of various NaCl concentrations (ranging from 0 to 300 mmol/L) on osmotic adjustment substances content, chlorophyll content, and antioxidant enzyme activity in *M. deliciosa* Liebm.

The findings of the experiment unveil intriguing patterns in *M. deliciosa* Liebm's physiological and biochemical characteristics during salt stress. The content of soluble sugar, soluble protein, and proline initially increased and then declined as the NaCl concentration and the duration of salt stress increased. This increase was more pronounced at lower NaCl concentrations (100 mmol/L) compared to the control. However, at higher NaCl concentrations (300 mmol/L), the content of these osmotic adjustment chemicals began to diminish, except for proline content, which started to decrease after 40 days of stress initiation.

Malondialdehyde, a marker of lipid peroxidation and oxidative damage, exhibited the opposite trend, initially decreasing and then increasing. The activities of superoxide dismutase (SOD), peroxidase (POD), and catalase (CAT) initially increased and subsequently began to decline as the NaCl concentration and the duration of salt stress increased. These activities were higher compared to the control, regardless of whether the NaCl concentration was lower or higher.

In summary, *M. deliciosa* Liebm may enhance osmotic adjustment molecules and activate antioxidant defense mechanisms to mitigate damage caused by NaCl stress, particularly at lower NaCl concentrations (100 mmol/L).

Cytotoxic Activities :

Lira *et al.*[9] explored the cytotoxic properties of two widely used medicinal plants, *Phyllanthus amarus* and *Monstera deliciosa*, through a brine shrimp lethality bioassay. The authors aimed to identify potential lead compounds for the development of novel and safe medicinal agents, highlighting the significance of medicinal plants in Bangladesh's traditional medicine, with a focus on *Phyllanthus amarus* and *Monstera deliciosa*. The brine shrimp lethality bioassay was used to assess the cytotoxic activity of the Ethyl acetate extracts, a widely accepted method for bioactivity screening. The results showed that the *Phyllanthus amarus* ethyl acetate extract demonstrated strong cytotoxicity, with LC_{50} values for the leaves being 9.15 g/ml and for the total plant being 20.16 g/ml. While *Monstera deliciosa* exhibited cytotoxicity, its LC_{50} values were greater, measuring 36.60 g/ml for the leaves

and 300.4 g/ml for the branches. These results imply the presence of cytotoxic compounds in *Phyllanthus amarus*, with the leaves showing more potency than the plant as a whole. While the branches of *Monstera deliciosa* did not display any significant cytotoxic effects, the extracts from the leaves only showed modest cytotoxicity.

Prosanta *et al*.[20,21] conducted a study to determine the anticancer and antioxidant effects of *Monstera deliciosa*'s methanol extract (MEMD) on Ehrlich ascites carcinoma (EAC) treated mice. In order to better understand MEMD's potential as an anticancer treatment, the authors investigated how it affected tumor growth, cell viability, hematological parameters, biochemical estimates, and antioxidant status. In vitro cytotoxicity assays assessed MEMD's direct effects on EAC cell lines. In vivo evaluation involved mice treated with MEMD at 50 and 100 mg/kg for 9 days, measuring tumor volume, cell count, weight, hematology, biochemical estimations, and antioxidant parameters. MEMD showed significant dose-dependent cytotoxicity against EAC cell lines in vitro and in vivo, reducing tumor volume, viable cell count, and weight in EAC tumor-bearing mice. It also increased overall lifespan and restored normal hematological and biochemical parameters. MEMD's positive impact on liver antioxidant status further supports its potential as an antioxidant agent.

Antidiabetic :

Meenakumari and Jella[10] investigated the antidiabetic and antioxidant properties of the ethanolic extract of *Monstera adansonii* flowers. Their acute toxicity study confirmed the extract's safety up to 2000 mg/kg in mice. In diabetic rats, the extract significantly reduced blood glucose levels, comparable to Glibenclamide, and improved lipid profiles, kidney function, and liver enzyme activities. The extract also demonstrated antioxidant activity by reducing malondialdehyde (MDA) levels and enhancing liver enzymatic antioxidants, indicating reduced lipid peroxidation and improved oxidative stress response. Histopathological examinations showed no significant pathological changes in liver and kidney tissues.

This review sheds light on the broad spectrum of pharmacological actions exhibited by Monstera plants, encompassing antibacterial, antioxidant, cytotoxic, and other therapeutic qualities, through an exploration of its phytochemical constituents and comprehensive research.

Phytochemical investigations have revealed that Monstera plants contain a diverse array of bioactive substances, including phenolic compounds, alkaloids, flavonoids, and terpenoids. These compounds contribute to the plant's pharmacological functions and hold promise for various medicinal applications. Studies on Monstera extracts have demonstrated their efficacy against a wide range of pathogens, including bacteria, fungi, and viruses, indicating their potential as natural remedies for microbial diseases.

Furthermore, research into the antioxidant properties of Monstera plants has highlighted their ability to scavenge free radicals and reduce oxidative stress. This antioxidative capacity may have implications for the treatment or prevention of various oxidative damage-related illnesses, such as cancer, neurological disorders, and cardiovascular

diseases. Alongside their antibacterial and antioxidant activities, Monstera plants have also shown cytotoxic effects on cancer cells. Numerous studies have reported their ability to inhibit the growth and induce apoptosis in various cancer cell lines, underscoring their potential as a source of novel anticancer compounds.

Overall, the literature reviewed underscores the significant potential of Monstera plants in medicinal chemistry. Their rich phytochemical profile and observed pharmacological actions open up new avenues for further research and the development of natural products for therapeutic purposes.

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