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"A COMPREHENSIVE REVIEW OF THE PHARMACOLOGICAL PROPERTIES OF *HYOSCYAMUS NIGER (L.)* EXTRACT AND *CURCUMIN* "

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Abstract : This study provides a comprehensive overview of *Hyoscyamus niger L.* (Black Henbane) and Curcuma longa L. (Turmeric), emphasizing their botanical characteristics, geographical distribution, phytochemical profiles, and pharmacological properties, particularly in relation to neurodegenerative disorders like Parkinson's disease. *Hyoscyamus niger L.,* belonging to the Solanaceae family, is a rich source of tropane alkaloids such as hyoscyamine and scopolamine, along with flavonoids, tannins, and steroidal glycosides.[1] It is native to temperate regions of Europe and Siberia and thrives in disturbed areas. Morphologically, it is a bushy plant with dark green leaves and tubular flowers. Its phytoconstituents contribute to various pharmacological effects including antiparkinsonian, cardioprotective, antidiarrheal, antipyretic, anti-inflammatory, analgesic, antidepressant, and anticonvulsant activities.[2] Curcuma longa, from the Zingiberaceae family, is cultivated primarily in tropical Asia, especially India.[3] It is known for its bright yellow rhizomes, which contain *curcumin* a polyphenol with strong anti-inflammatory, antioxidant, and neuroprotective properties. The plant also contains essential oils, phenolic compounds, and various minerals and vitamins.[4] Experimental models demonstrate that *curcumin* exerts significant antiparkinsonian effects by modulating oxidative stress, reducing neuroinflammation, and protecting dopaminergic neurons. Both plants offer significant therapeutic potential, especially in managing neurological and cardiovascular conditions, and merit further clinical investigation for their integration into modern medical applications.[5]

***Keywords*:** Reactive oxygen species (ROS), Desmethoxycurcumin (DMC), Bisdemethoxycurcumin (BDMC), 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP), cyclooxygenase (COX), Monoamine oxidase (MAO), Gamma-aminobutyric acid (GABA), Lipopolysaccharides (LPS), 6-hydroxydopamine (6-OHDA), Intracerebral haemorrhage (ICH), Pentylenetetrazol (PTZ).

I. INTRODUCTION

1. *Hyoscyamus niger L.*

The biological source of *Hyoscyamus niger L.* (commonly known as Black Henbane) is a plant belonging to the Solanaceae (nightshade) family. The scientist associated with the binomial name Hyoscyamus niger is Carl Linnaeus. Its seeds are one of the primary parts of the plant used for medicinal and pharmaceutical purposes.[1] These plants are rich in tropane alkaloids, mainly hyoscyamine and scopolamine. Phytochemical studies have shown that Hyoscyamus species contain alkaloids, flavonoids, tannins, terpenes, saponins, carbohydrates, cardiac glycosides, and anthraquinones. They have several health benefits, including anti-diabetic, antioxidant, anticancer, insecticidal, antiasthmatic, antiallergic, antidiarrheal, antisecretory, and blood pressure-lowering effects. They also protect the heart and liver, help manage high uric acid levels, treat Parkinson's disease, prevent seizures, improve mood, and have anticholinergic effects due to their tropane alkaloids.[2]

Scientific classification of *Hyoscyamus niger L.*:

- **Scientific name**: *Hyoscyamus niger L.*
- **Family**: *Solanaceae*
- **Genus**: *Hyoscyamus*
- **Order**: *Solanales*
- **Higher classification**: *Henbanes*
- **Rank**: *Species*
- **Kingdom**: *Plantae* [6]

1. *Curcuma longa* (Turmeric): *Curcumin*

Turmeric (Curcuma longa L.) is a plant from the *Zingiberaceae* family. It is widely grown for its underground stems, called *rhizomes*.[3] The scientist linked to the plant *Curcuma longa* is *Linnaeus.* He was the one who first described and named it. *Turmeric* is a spice from the root of the *Curcuma longa L.* plant, which is related to ginger. Its bright yellow color comes from compounds called curcuminoids, with curcumin being the most active. *Turmeric* has been used in India for centuries for its medicinal properties, and research shows *curcumin* may help reduce inflammation and fight cancer. *Curcumin* is a polyphenol responsible for *turmeric's* yellow color and has antioxidant, anti-inflammatory, antiviral, and antifungal effects. It's also non-toxic to humans. *Curcumin* can help reduce inflammation, prevent atherosclerosis, and assist in post-surgery recovery.[4] It has anti-inflammatory, anti-HIV, antibacterial, antioxidant, and other therapeutic effects. *Turmeric* can neutralize harmful molecules called reactive oxygen species (ROS), including superoxide, hydroxyl radicals, and nitric oxide. It also inhibits enzymes that cause inflammation, such as cyclooxygenase (COX-I and COX-II). *Turmeric* helps protect cells from oxidative damage and prevents harmful substances from binding to DNA.[5]

Scientific classification of *Curcuma longa* (Turmeric):

- **Scientific name:** *Curcuma longa*
- **Higher classification:** *Hidden-lilies*
- **Family:** *Zingiberaceae*
- **Rank:** Species
- **Genus:** *Curcuma*
- **Kingdom:** *Plantae*
- **Order:** *Zingiberales* [7]

GEOGRAPHICAL DISTRIBUTION

1. *Hyoscyamus niger L.*

➢ **Growth:** *Hyoscyamus niger L. (henbane)* typically grows to a height of 1 to 2 meters (3 to 6 feet). It has a bushy appearance with broad, dark green leaves and produces yellowish to purple flowers.[6]

➢ **Native:** *Hyoscyamus niger, or henbane,* is native to temperate regions of Europe and Siberia. It has also been naturalized in parts of North America, and can be found in areas with suitable climates across the world. It typically grows in disturbed areas, such as roadsides, fields, and waste grounds.[8]

2. *Curcuma longa* (Turmeric): ***Curcumin***

➢ **Growth:** Turmeric (*Curcuma longa*) is a perennial plant belonging to the ginger family (Zingiberaceae), known for its vibrant yellow rhizomes. It grows best in warm, humid climates with ample rainfall and typically reaches a height of about one meter. The plant is cultivated primarily for its underground stems, or rhizomes, which are dried and ground into a spice widely used in South Asian cuisine.

➢ **Native:** Native to the Indian subcontinent and Southeast Asia, turmeric thrives in tropical and subtropical regions and is now cultivated globally in suitable climates. Its popularity stems from both culinary and medicinal uses, with *curcumin*—the primary active compound—being responsible for many of its therapeutic properties.[9]

MORPHOLOGY

1. *Hyoscyamus niger L.*

- **Height**: The plant typically grows between 1 to 2 meters (3 to 6 feet) tall.
- **Stem**: The stem is upright, thick, and covered with soft, dense hairs.
- **Leaves**: The leaves are large, broad, and alternate, they have a rough texture and are typically covered with fine hairs, giving them a slightly sticky feel. The leaf margins are irregularly toothed or lobed. The leaves are dark green and can grow up to 20 cm (8 inches) in length.
- **Flowers**: Henbane produces tubular flowers that are arranged in clusters (racemes) at the top of the stem. The flowers are typically yellow or pale yellow with purple veins and have a foul odor, contributing to the plant's common name "stinking nightshade." Each flower has five petals and a distinct, funnel-shaped structure.

- **Fruit**: The fruit is a small, round capsule containing many seeds. The seeds are light brown and small, typically around 1-2 mm in size.
- **Roots**: The roots are thick, fleshy, and branched, characteristic of many members of the *Solanaceae (nightshade)* family.

2. *Curcuma longa* (Turmeric): *Curcumin*

- **Height**: It is a herbaceous perennial plant that typically grows to a height of 1 to 1.5 meters (3 to 5 feet).
- **Roots**: Turmeric has thick, fleshy rhizomes (underground stems) that are orange or yellow in color and are harvested for culinary and medicinal uses. These rhizomes are branched and have a distinct earthy, spicy aroma.
- **Leaves**: The plant has large, elongated, lance-shaped leaves that are green and glossy. They are arranged in a way that forms a leafy clump at the base of the plant. The leaves can grow up to 60 cm (24 inches) in length.
- **Stem**: Turmeric has a short, erect stem that is covered by the large leaves.
- **Flowers**: Turmeric produces small, pale yellow or white flowers that grow in dense spikes or cones. The flowers have a characteristic, funnel-shaped appearance, and they emerge from the plant's rhizome towards the top of the stem.
- **Fruit**: The plant does not typically produce a significant amount of fruit as it is propagated primarily by rhizomes.[9]

PHYTOCHEMISTRY

1. *Hyoscyamus niger L.*

- **Tropane alkaloids:** Contains 0.06–0.13% of hyoscyamine, apohyoscine, scopolamine, skimmianine, apoatropine, and belladonnine present in the seed of *Hyoscyamus niger L.* [10]
- **Steroidal Glycosides:** Hyoscyamoside A, B, C, D, E, F are present .[11,12]
- **Flavonoids:** like Rutin, Quercetin, Kaempherol.
- **Furostanol and Spirostanol Saponins:** Two furostanol and four spirostanol saponins were found in the seeds.[13,14]
- **Lignanamides and Other Non-Alkaloidal Components:** Hyoscyamide, grossamide, various glycerol derivatives, cannabisin D and G, rutin, vanillic acid, β-sitosterol, and daucosterol.[15]
- **Withanolide Steroids:** Daturalactone-4, hyoscyamilactol, and 16α-acetoxyhyoscyamilactol.[16]
- **Phenolic Content:** Gallic acid .[17]

2. *Curcuma longa* (Turmeric): *Curcumin*

- ***Curcuminoids*:** *Curcumin, demethoxycurcumin, and bisdemethoxycurcumin*: 3-6%.[18,19]
- **Phenolic compound:** Diferuloylmethane, Curcuminoid

- **Volatile oil:** Curcumenone, Dehydrocurdione, Germacrone 4,5-epoxide, Bisabola 3,10-diene-2-one, Arturmerone, Bisacumol, Bisacurone, Curcumenol, Isoprocurcumenol, Zedoaronediol, Procurcumenol, Epiprocurcumenol. And Germacrone-13-al, Hydroxybisabola compounds, Procurcumadiol [20,21]
- **Other compounds:** Curlone, α-Turmerone, β-Turmerone, Terpinolene, α-Phellandrene, Curcumadiol, Labda-8(17)-diene-15, 16-dial [22]

○ **Turmeric shown Neuroprotective and Anti-inflammatory properties, Antioxidant which help to reduce PD symptoms that Chemical constituents are:**

Curcuminoids: Curcumin (curcumin 1: 77%), Desmethoxycurcumin (DMC: Curcumin 2: 17%), Bisdemethoxycurcumin (BDMC: Curcumin 3: 3%)

○ **Other Chemical constituents of turmeric:**

70% carbohydrates, 6% protein, 6% essential oils (phellandrene, sabinene, cineol, borneol, zingiberene and sesquiterpenes), 5% fat, 3% mineral (potassium, calcium, phosphorus, iron, and sodium), 3–5% curcuminoids, vitamins (B1, B2, C, and niacin)

PHARMACOLOGICAL PROPERTIES

1. *Hyoscyamus niger L.*

Table No. 2.1: Pharmacological Activities of *Hyoscyamus niger L.*

Pharmacological Activity	Extract	Dose	Model	Reference
Antiparkinson activity	Methanolic extract of seeds	500mg/kg p.o.	MPTP Induced Parkinson disease in mice	Sengupta, et al.2010
Antiparkinson activity	Methanolic extract of seeds	500mg/kg p.o.	Rotenone Induced Parkinson disease in rat	Khatri, et al.2015
Cardio protective activity	Crude powder of seeds	100mg/kg p.o.	Isoproterenol induced myocardial injury in rats	Vallabi, et al.2016
Antidiarrheal activity	Methanolic extract of seeds	300mg/kg p.o.	Castor oil induced diarrhea in mice	Gilani, et al.2007
Antipyretic activity	Methanolic extract of seeds	400mg/kg p.o.	Aq.solution of yeast induced fever in rat	Begum. S, et al.2009

Anti-inflammatory activity	Methanolic extract of seeds	400mg/kg p.o.	Cotton pellet method	Begum. S, et al.2009
Analgesic activity	Methanolic extract of seeds	400mg/kg p.o.	Hot plate method	Begum. S, et al.2009
Antidepressant activity	Ethanolic extract of leaves	400mg/kg p.o.	Tail suspension test	Patil, et al.2013
Anti-Seizure activity	Methanolic Extract of seeds	400mg/kg p.o.	Picrotoxin induced seizure	Reza, et al.2009

1. Antiparkinson Activity: The methanolic extract of *Hyoscyamus niger* seeds has been studied for its antiparkinsonian effects at a dose of 500 mg/kg administered orally in animal models of Parkinson's disease, including MPTP-induced Parkinsonism in mice and Rotenone-induced Parkinsonism in rats. Both models mimic dopaminergic neuron degeneration seen in Parkinson's disease. The extract is believed to exhibit neuroprotective properties by mitigating oxidative stress and preventing dopaminergic neuronal loss. Phytochemicals such as tropane alkaloids, flavonoids, and phenolic compounds contribute to the antioxidant effects, possibly by scavenging free radicals and modulating mitochondrial function. Additionally, the extract may influence neurotransmitter levels, particularly dopamine, thus alleviating motor symptoms associated with Parkinson's disease.[23,24]

2. Cardioprotective Activity: The crude seed powder of *Hyoscyamus niger*, when administered at 100 mg/kg orally, has shown cardioprotective effects in isoproterenol-induced myocardial infarction in rats. Isoproterenol is known to induce cardiac damage through oxidative stress and inflammation. The cardioprotective potential of the seed powder is attributed to its ability to reduce lipid peroxidation and restore antioxidant enzyme levels in cardiac tissues. This protective mechanism likely involves the inhibition of inflammatory cytokines and stabilization of cell membranes, thereby preventing cellular leakage and necrosis. The antioxidant-rich phytochemical profile of *H. niger* seeds, including polyphenols and alkaloids, plays a crucial role in preserving myocardial integrity under stress conditions.[25]

3. Antidiarrheal Activity: The methanolic extract of *Hyoscyamus niger* seeds, administered orally at 300 mg/kg, has demonstrated significant antidiarrheal activity in castor oil-induced diarrhea models in mice. Castor oil increases intestinal motility and secretion by releasing ricinoleic acid, which irritates the intestinal mucosa and stimulates prostaglandin formation. The extract likely acts through its anticholinergic components, such as hyoscyamine and scopolamine, which inhibit muscarinic receptors in the gastrointestinal tract, thereby reducing peristalsis and fluid secretion. This mechanism results in decreased intestinal transit

and fluid loss, ultimately controlling diarrhea. The presence of tannins and flavonoids may also contribute by enhancing intestinal absorption and reducing mucosal inflammation.[26]

4. Antipyretic Activity: The methanolic seed extract, at a dose of 400 mg/kg orally, has been evaluated for antipyretic activity using a yeast-induced fever model in rats. This model mimics the elevation of body temperature via the release of pyrogens that stimulate prostaglandin E2 (PGE2) production in the hypothalamus. The extract appears to exert its antipyretic effect by inhibiting the cyclooxygenase (COX) pathway, thereby reducing PGE2 synthesis and lowering the hypothalamic set point for body temperature. The antipyretic action may also be supported by the presence of flavonoids and alkaloids that suppress cytokine activity and modulate thermoregulatory processes in the brain.[27]

5. Anti-inflammatory Activity: In the cotton pellet-induced granuloma model, a standard method for assessing chronic inflammation, the methanolic extract of *Hyoscyamus niger* seeds at 400 mg/kg orally showed significant anti-inflammatory activity. This effect is believed to result from the inhibition of pro-inflammatory mediators such as prostaglandins, histamine, and bradykinin. The extract's alkaloid constituents, particularly tropane alkaloids, are known to have membrane-stabilizing effects that prevent lysosomal enzyme release and tissue damage. Furthermore, its antioxidant compounds may reduce oxidative stress associated with inflammatory responses, thereby promoting tissue repair and reducing granuloma formation.[27]

6. Analgesic Activity: The analgesic potential of *Hyoscyamus niger* seed extract was evaluated using the hot plate method in rodents, a model for central pain perception. At a dosage of 400 mg/kg orally, the methanolic extract demonstrated significant analgesic activity. The mechanism likely involves the modulation of opioid receptors or inhibition of prostaglandin synthesis in the central nervous system, both of which play key roles in pain sensation. The plant's anticholinergic constituents may also contribute by reducing nerve excitability and altering nociceptive transmission pathways. These combined effects result in elevated pain thresholds and reduced pain perception in the experimental models.[27,28]

7. Antidepressant Activity: The ethanolic extract of *Hyoscyamus niger* leaves, administered orally at 400 mg/kg, showed antidepressant activity in the tail suspension test, a behavioral model of depression in mice. The mechanism of action is thought to involve modulation of central monoamine neurotransmitters such as serotonin, norepinephrine, and dopamine. The extract may act as a monoamine oxidase (MAO) inhibitor or reuptake inhibitor, thereby increasing the availability of mood-regulating neurotransmitters in the synaptic cleft. Additionally, its antioxidant properties may offer neuroprotective effects by preventing oxidative damage to neural tissues, which is often implicated in the pathophysiology of depression.[29]

8. Anti-Seizure Activity: At an oral dose of 400 mg/kg, the methanolic extract of *Hyoscyamus niger* seeds exhibited anti-seizure activity in picrotoxin-induced seizure models. Picrotoxin is a GABA receptor antagonist that induces convulsions by blocking inhibitory neurotransmission. The extract's antiepileptic

effect is hypothesized to result from the enhancement of GABA nergic neurotransmission or inhibition of excitatory glutamate pathways. Tropane alkaloids may also act on central nervous system receptors to stabilize neuronal membranes and reduce excitability. This pharmacological action helps delay seizure onset and reduce seizure severity in treated animals.[30]

2. *Curcuma longa* (Turmeric): *Curcumin*

Table No. 2.1: Pharmacological Activities of *Curcuma longa* (Turmeric): *Curcumin*

Pharmacological Activity	Dose	Model	Reference
Antiparkinson Activity	150mg/kg p.o.	Rotenone induce Parkinson disease in mice	Shamarka, et al.2022
Antiparkinson Activity	80mg/kg p.o.	6OHDA induce Parkinson disease in rat	Khuwaja, et al.2010
Antiparkinson Activity	200mg/kg p.o.	Rotenone induce Parkinson disease in mice	Khatri, et al.2016
Antiparkinson Activity	40mg/kg i.p.	Lipopolysaccharides (LPS) induce Parkinson disease in rat	Sharma, et al.2017
Antiparkinson & Neuroprotective	150mg/kg i.p.	Intracerebral Haemorrhage model in mice	King, et al.2011
Antiparkinson	80mg/kg i.p.	MPTP induce Parkinson disease in mice	Rajeshwari, et al.2007
Antiepileptics	300mg/kg p.o.	PTZ induced epilepsy model rat	Menla, et al.2010
Prevent hippocampal injury	20mg/kg p.o.	6OHDA induced injury in rat model	Yang, et al.2014
Antidiabetic	500mg/kg s.c.	High Fat induced obesity in mice	Eiaz, et al.2009
Antithrombotic	500mg/kg p.o.	Myocardial ischemia reperfusion rat by ramipril	Prakash, et al. 2010
Antithrombotic	200mg/kg i.p.	Adrenaline induced thrombotic in mice model	Srivastava, et al.1985

Neuroprotective ischemia	500mg/kg p.o.	Embolic cerebral ischemia was induced by injecting multiple fibrin-rich autologous clots one after another into external carotid artery	Dohare, et al.2008
Cerebral ischemia/reperfusion injury	250 mg/kg i.p.	Ischemia was induced by intraluminal filament technique	Dohare, et al.2008

1. Antiparkinson Activity

Curcumin has been extensively studied for its neuroprotective potential in models of Parkinson's disease (PD), a chronic neurodegenerative disorder characterized by the selective loss of dopaminergic neurons in the substantia nigra. One commonly used experimental model is rotenone-induced Parkinson's in mice, where rotenone—a pesticide that inhibits mitochondrial complex I—causes neuronal death and motor deficits similar to human PD. In this model, curcumin at a dose of 150 mg/kg administered orally was found to significantly reduce neurodegeneration and oxidative stress, as reported by Shanmukha et al. (2022).[31] Another study utilized 6-hydroxydopamine (6-OHDA), a neurotoxin that selectively destroys dopaminergic neurons, to induce PD-like symptoms in rats. Khuwaja et al. (2010) demonstrated that curcumin at 80 mg/kg orally could reverse the oxidative damage and restore motor function.[32] Similarly, Khatri et al. (2016) validated these findings by using a higher dose of 200 mg/kg, indicating a dose-dependent neuroprotective effect.[33]

Moreover, Sharma et al. (2017) employed a lipopolysaccharide (LPS)-induced PD model in rats, where neuroinflammation plays a primary role in dopaminergic neuron loss. Curcumin, at a dose of 40 mg/kg administered orally, significantly inhibited inflammation-related markers and preserved neuron integrity. Another notable model is the MPTP-induced PD model, a widely accepted method for studying PD in mice.[34] Rajeswari et al. (2007) showed that curcumin at doses of 60 and 80 mg/kg (p.o.) mitigated MPTP-induced neurotoxicity, improved motor function, and reduced glial activation. Collectively, these studies underscore curcumin's ability to counteract both oxidative and inflammatory processes central to Parkinson's pathology.[35,36]

2. Neuroprotection in Intracerebral Haemorrhage

In addition to Parkinson's disease, curcumin has shown neuroprotective properties in haemorrhagic stroke models. King et al. (2011) used an intracerebral haemorrhage (ICH) model in mice, where brain damage was induced by injecting blood into the brain parenchyma. A 150 mg/kg intraperitoneal dose of curcumin resulted in significant protection against neuronal damage. The compound was found to reduce cerebral edema, lipid peroxidation, and microglial activation. This suggests that curcumin's ability to modulate oxidative and

inflammatory responses can help maintain neuronal function and limit damage in haemorrhagic brain injury.[35]

3. Antiepileptic Activity

Curcumin has also demonstrated promising antiepileptic effects. Menka et al. (2011) investigated its efficacy in a PTZ-induced epilepsy model in rats, where pentylenetetrazol (PTZ) triggers seizures by inhibiting GABAergic neurotransmission. Administering 300 mg/kg of curcumin intraperitoneally significantly reduced seizure frequency and severity. The compound's mechanism is thought to involve enhancement of GABA activity, suppression of oxidative stress, and stabilization of neuronal membranes. These findings support the use of curcumin as a potential adjunct therapy for managing epilepsy.[37]

4. Protection Against Hippocampal Injury

In models of hippocampal damage, particularly involving the 6-OHDA-induced injury in rats, curcumin has shown notable protective effects. Yang et al. (2014) explored the ability of curcumin to prevent hippocampal neurodegeneration at a relatively low oral dose of 20 mg/kg. Their findings revealed that curcumin attenuated neuronal death, preserved cognitive function, and reduced the production of reactive oxygen species (ROS). This indicates that even at lower doses, curcumin can protect vulnerable brain regions like the hippocampus, which are critical for memory and learning.[38]

5. Antidiabetic Activity

Curcumin also exerts significant antidiabetic effects, particularly in the context of diet-induced metabolic dysfunction. Elias et al. (2009) used a high-fat diet-induced obesity model in mice to examine the effect of curcumin on metabolic parameters. Administering a high subcutaneous dose of 500 mg/kg, they found that curcumin reduced body weight gain, improved insulin sensitivity, and lowered fasting blood glucose levels. The mechanism is believed to involve modulation of insulin signaling pathways, reduction of adipose tissue inflammation, and enhancement of antioxidant defenses. These findings suggest that curcumin could serve as a beneficial supplement for preventing or managing type 2 diabetes.[39]

6. Antithrombotic and Cardioprotective Effects

Curcumin has demonstrated strong antithrombotic and cardioprotective effects in experimental models. Prakash et al. (2010) evaluated its role in a myocardial ischemia-reperfusion model in rats, where blood flow was temporarily occluded and then restored, mimicking a heart attack scenario. Oral administration of 500 mg/kg of curcumin significantly reduced infarct size and myocardial damage. This effect was attributed to curcumin's ability to suppress oxidative stress and improve cardiac antioxidant enzyme activity.[40]

Additionally, Srivastava et al. (1985) used an adrenaline-induced thrombotic model in mice to assess curcumin's anti-clotting properties. A dose of 200 mg/kg given intraperitoneally effectively prevented clot formation, likely by inhibiting platelet aggregation and reducing pro-thrombotic mediators. These results

indicate that curcumin could help manage or prevent cardiovascular events by maintaining vascular homeostasis.[41]

7. Neuroprotection in Ischemic Stroke

Curcumin's neuroprotective effects extend to ischemic stroke models as well. Dohare et al. (2008) used two different approaches: one involving embolic cerebral ischemia induced by injecting multiple fibrin-rich autologous clots into the carotid artery, and another involving ischemia-reperfusion injury caused by temporarily occluding the middle cerebral artery using an intraluminal filament. In both models, curcumin at 500 mg/kg orally and 250 mg/kg intraperitoneally, respectively, provided substantial neuroprotection. It reduced infarct volume, preserved neurological function, and maintained the integrity of the blood-brain barrier. These effects are thought to be mediated through anti-inflammatory signalling, reduction of excitotoxicity, and antioxidant pathways.[42,43]

NEED OF THE STUDY.

Both plants show promising pharmacological activities in preclinical studies. This would help in understanding their potential as therapeutic agents for managing neurodegenerative disorders. Understanding how these compounds interact with biological systems at a molecular level could lead to the development of more targeted therapies. Medicinal plants have long been recognized as a valuable source of bioactive compounds with therapeutic potential. *Hyoscyamus niger L.* (black henbane), a member of the Solanaceae family, has been traditionally used in various cultures for its sedative, antispasmodic, and analgesic properties. Despite its well-documented use in folk medicine, comprehensive scientific validation of its pharmacological activities remains limited and scattered across different disciplines. With the growing global interest in herbal medicine and plant-based drug discovery, there is a critical need to consolidate existing knowledge on the pharmacological potential of *Hyoscyamus niger*. Moreover, given the plant's known toxicity and psychoactive effects, it becomes even more important to assess its pharmacological activities through a scientific lens to guide safe and effective application. This study aims to provide an updated, evidence-based overview of *Hyoscyamus niger's* pharmacological properties, encouraging further research and supporting its potential integration into modern pharmacotherapy with appropriate caution. *Curcumin* a polyphenol with strong anti-inflammatory, antioxidant, and neuroprotective properties. The plant also contains essential oils, phenolic compounds, and various minerals and vitamins. Neurodegenerative disorders such as Parkinson's disease (PD), Alzheimer's disease (AD), and stroke continue to pose significant global health challenges, with limited therapeutic options that primarily offer symptomatic relief rather than disease modification. In this context, naturally occurring compounds with multifaceted biological properties have garnered considerable attention for their potential neuroprotective roles. Curcumin, a polyphenolic compound derived from the rhizome of *Curcuma longa*, has emerged as a promising candidate due to its well-documented antioxidant, anti-inflammatory, anti-apoptotic, and neuroregenerative properties. Despite a growing body of preclinical

evidence supporting curcumin's efficacy in various experimental models of neurological disorders, its translation into clinical practice remains limited, partly due to issues such as poor bioavailability, variability in dosing regimens, and insufficient clinical data. A comprehensive synthesis of the available literature is therefore essential to consolidate current knowledge, identify gaps, and guide future research directions. This review aims to critically evaluate the neuroprotective potential of curcumin across different experimental models, highlight its mechanisms of action, and discuss strategies to overcome pharmacokinetic limitations. Such an integrative approach is crucial for advancing curcumin-based therapeutics and optimizing its clinical utility in neurodegenerative diseases.

CONCLUSION:

Hyoscyamus niger L. commonly known as black henbane, is a plant of considerable pharmacological interest due to its rich phytochemical composition and diverse biological activities. The presence of tropane alkaloids such as hyoscyamine, scopolamine, and atropine underpins its well-documented anticholinergic effects, which have found clinical applications in the management of motion sickness, gastrointestinal disorders, and certain neurological conditions. Beyond its traditional uses, recent scientific studies have highlighted the plant's potential in exhibiting antioxidant, antimicrobial, analgesic, anti-inflammatory, and cytotoxic properties. These findings suggest its possible role in modern therapeutic interventions, particularly in areas where conventional treatments face limitations or resistance. However, the plant's narrow therapeutic window and notable toxicity underscore the need for caution in its medicinal application. Further pharmacological, toxicological, and clinical investigations are essential to validate its efficacy, establish standardized dosing, and ensure safety for human use. With a balanced approach to its benefits and risks, *Hyoscyamus niger L.* holds promise as a valuable natural resource in the development of novel pharmaceutical agents. Curcumin, a bioactive compound from *Curcuma longa*, has demonstrated significant therapeutic potential across a wide range of neurological disorders, particularly through its antioxidant, anti-inflammatory, anti-apoptotic, and neuroregenerative properties. Preclinical studies have consistently shown curcumin's ability to attenuate neuronal damage, reduce oxidative stress, and modulate key inflammatory pathways in various experimental models of Parkinson's disease, Alzheimer's disease, intracerebral hemorrhage, and other neurodegenerative conditions. Despite these promising findings, the clinical translation of curcumin remains hindered by challenges such as poor bioavailability, limited solubility, and rapid metabolism. However, advancements in drug delivery systems including nanoparticles, liposomes, and curcumin analogs offer promising strategies to enhance its pharmacokinetic profile. *Curcumin* represents a promising multifunctional therapeutic agent for neuroprotection.

REFERENCES

1. A. Naseem, Y. Liu, A. Nazli, H. Kuang, and Bing-You Yang. 2023. "An Insight into Indigenous Ethnobotanical and Pharmacological Potential of Solanaceae Family in Pakistan: A Review." Journal of Herbal Medicine 42: 100763.
2. Al-Snafi, Ali PY. 2018. "Therapeutic Importance of Hyoscyamus Species Grown in Iraq (Hyoscyamus albus, Hyoscyamus niger and Hyoscyamus reticulates): A Review." IOSR Journal of Pharmacy 8 (6, Version I): 18–32.
3. Maheshwari, Radha K., Anoop K. Singh, Jaya Gaddipati, and Rikhab C. Srimal. 2006. "Multiple biological activities of curcumin: A short review." Life Sciences 78(18): 2081–2087. https://doi.org/10.1016/j.lfs.2005.12.007.
4. Akram, Muhammad, Arslan Afzal, Unisha Khan, H. Abdul, Ejaz Mohiuddin, and Muhammad Asif. 2010. "Curcuma longa and Curcumin: A review article." Romanian Journal of Biology – Plant Biology 55: 65–70.
5. Niranjan, Abhishek, and Dhan Prof. 2008. "Chemical constituents and biological activities of turmeric (Curcuma longa L.): A review." Journal of Food Science and Technology 45: 109–116.
6. Duke, James A. 1985. CRC Handbook of Medicinal Herbs. Boca Raton: CRC Press, 297–300.
7. Chanda, Sayantani, and T. V. Ramachandra. 2019. "Phytochemical and Pharmacological Importance of Turmeric (Curcuma longa): A Review." Research & Reviews: A Journal of Pharmacology 9(1).
8. Kennedy, David O. 2014. "The Deliriants: The Nightshade (Solanaceae) Family." In Plants and the Human Brain, 131–37. New York: Oxford University Press.
9. Sontsa-Donhoung, A., Hawaou, M. Bahdjolbe, G. Nekou, I. Tadjouo, and D. Nwaga. 2021. "Growing Curcuma longa for Rhizome Production on Diverse Arable Soil Types in Cameroon: Agronomic and Microbial Parameters." Agricultural Sciences 12: 464–480.
10. Zhang, W., W. Zhang, J. Luo, and L. Kong. 2013. "A New Steroidal Glycoside from the Seeds of Hyoscyamus niger." Journal of Natural Product Research 27 (21): 1971–74.
11. Zhang, W. N., J. G. Luo, and L. Y. Kong. 2012. "Phytotoxicity of Lignanamides Isolated from the Seeds of Hyoscyamus niger." Journal of Agricultural and Food Chemistry 60 (7): 1682–1687. https://doi.org/10.1021/jf2046784.
12. Alizadeh, A., M. Moshiri, J. Alizadeh, and M. Balali-Mood. 2014. "Black Henbane and Its Toxicity – A Descriptive Review." Avicenna Journal of Phytomedicine 4 (5): 297–311.
13. Lunga, I., P. Chintea, S. Shvets, A. Favel, and C. Pizza. 2007. "Steroidal Glycosides from the Seeds of Hyoscyamus niger and Their Antifungal Activity." Chemistry Journal of Moldova 2 (1): 108–113.
14. Lunga, I., P. Kintia, S. Shvets, C. Bassarello, C. Pizza, and S. Piacente. 2006. "Three Spirostanol Glycosides from the Seeds of Hyoscyamus niger L." Chemistry Journal of Moldova 1: 123–127.
15. Ma, C. Y., W. K. Liu, and C. T. Che. 2002. "Lignanamides and Nonalkaloidal Components of Hyoscyamus niger Seeds." Journal of Natural Products 65 (2): 206–209.
16. Ma, C. Y., I. D. Williams, and C. T. Che. 1999. "Withanolides from Hyoscyamus niger Seeds." Journal of Natural Products 62 (10): 1445–1447.
17. Hajipoor, K., A. M. Sani, and A. Mohammad. 2015. "In Vitro Antioxidant Activity and Phenolic Profile of Hyoscyamus niger." International Journal of Biology, Pharmacy and Allied Sciences 4 (7): 4882–4890.
18. Ravindranath, V., and M. N. Satyanarayana. 1980. "An unsymmetrical diarylheptanoid from Curcuma longa." Phytochemistry 19: 2031–2032.
19. Hayakawa, Hiroshi, Yukio Minaniya, Katsura Ito, Yoshinori Yamamoto, and Tatsuya Fukuda. 2011. "Difference of Curcumin Content in Curcuma longa L. (Zingiberaceae) Caused by Hybridization with Other Curcuma Species." American Journal of Plant Sciences 2(2).
20. Roth, G. N., A. Chandra, and M. G. Nair. 1998. "Novel bioactivities of Curcuma longa constituents." Journal of Natural Products 61: 542–545.
21. Ohshiro, M., M. Kuroyanagi, and A. Ueno. 1990. "Structures of sesquiterpenes from Curcuma longa." Phytochemistry 29: 2201–2205.
22. Kiso, Y., Y. Suzuki, Y. Oshima, and H. Hikino. 1983. "Stereostructure of curlone, a sesquiterpenoid of Curcuma longa rhizomes." Phytochemistry 22: 596–597.
23. Sengupta, T., J. Vinayagam, N. Nagashayana, et al. 2011. "Antiparkinsonian Effects of Aqueous Methanolic Extract of Hyoscyamus niger Seeds Result from Its Monoamine Oxidase Inhibitory and Hydroxyl Radical Scavenging Potency." Neurochemical Research 36: 177–186.

24.Khatri, D. K., and A. R. Juvekar. 2015. "Propensity of Hyoscyamus niger Seeds Methanolic Extract to Allay Stereotaxically Rotenone-Induced Parkinson's Disease Symptoms in Rats." Oriental Pharmacy and Experimental Medicine 15: 387–388.
25.Vallabi, D. E., and V. Elango. 2016. "Preliminary Studies on Cardio Protective Effect of Hyoscyamus niger Linn in Male Albino Rats." Journal of Chemical and Pharmaceutical Research 8 (7): 860–864.
26.Gilani, A. H., A. U. Khan, M. Raoof, M. N. Ghayur, B. S. Siddiqui, W. Vohra, and S. Begum. 2008. "Gastrointestinal, Selective Airways and Urinary Bladder Relaxant Effects of Hyoscyamus niger Are Mediated through Dual Blockade of Muscarinic Receptors and Ca^{2+} Channels." Fundamental & Clinical Pharmacology 22 (1): 87–99.
27.Begum, S., B. Saxena, M. Goyal, R. Ranjan, V. B. Joshi, Ch. V. Rao, S. Krishnamurthy, and M. Sahai. 2010. "Study of Anti-inflammatory, Analgesic and Antipyretic Activities of Seeds of Hyoscyamus niger and Isolation of a New Coumarinolignan." Fitoterapia 81 (3): 178–184. https://doi.org/10.1016/j.fitote.2009.08.024.
28.Ghosian, M. H., M. Moradi, and E. Yaghoutpoor. 2012. "Assessment of Hyoscyamus niger Seeds Alcoholic Extract Effects on Acute and Chronic Pain in Male NMRI Rats." Basic and Clinical Pathophysiology 1 (1): 29–36.
29.Patil, A. D., A. Y. Patil, and A. A. Raje. 2013. "Antidepressant-like Property of Hyoscyamus niger Linn. in Mouse Model of Depression." Innovations in Pharmaceuticals and Pharmacotherapy 1 (2): 60–69.
30.Reza, H. M., H. Mohammad, E. Golnaz, and S. Gholamreza. 2009. "Effect of Methanolic Extract of Hyoscyamus niger L on the Seizure Induced by Picritoxin in Mice." Pakistan Journal of Pharmaceutical Sciences 22 (3): 308–312.
31.El-Shamarka, M. E., O. M. Abdel-Salam, N. Shafee, and H. M. Zeidan. 2023. "Curcumin modulation of L-dopa and rasagiline-induced neuroprotection in rotenone model of Parkinson's disease." Iranian Journal of Basic Medical Sciences 26(2): 139–147. https://doi.org/10.22038/IJBMS.2022.61687.13650.
32.Khuwaja, Gulrana, and Mohd. Moshahid Khan. 2010. "Neuroprotective effects of curcumin on 6-hydroxydopamine-induced Parkinsonism in rats: Behavioral, neurochemical and immunohistochemical studies." Brain Research 1368: 254–263. https://doi.org/10.1016/j.brainres.2010.10.014.
33.Khatri, D. K., and A. R. Juvekar. 2016. "Neuroprotective effect of curcumin as evinced by abrogation of rotenone-induced motor deficits, oxidative and mitochondrial dysfunctions in mouse model of Parkinson's disease." Pharmacology Biochemistry and Behavior 150–151: 39–47. https://doi.org/10.1016/j.pbb.2016.09.002.
34.Sharma, N., and B. Nehru. 2018. "Curcumin affords neuroprotection and inhibits α-synuclein aggregation in lipopolysaccharide-induced Parkinson's disease model." Inflammopharmacology 26(2): 349–360. https://doi.org/10.1007/s10787-017-0402-8.
35.King, M. D., D. J. McCracken, F. M. Wade, S. E. Meiler, C. H. Alleyne Jr., and K. M. Dhandapani. 2011. "Attenuation of hematoma size and neurological injury with curcumin following intracerebral hemorrhage in mice: Laboratory investigation." Journal of Neurosurgery 115(1): 116–123.
36.Rajeswari, A., and M. Sabesan. 2008. "Inhibition of monoamine oxidase-B by the polyphenolic compound, curcumin and its metabolite tetrahydrocurcumin, in a model of Parkinson's disease induced by MPTP neurodegeneration in mice." Inflammopharmacology 16(2): 96–99. https://doi.org/10.1007/s10787-007-1614-0.
37.Mehla, J., K. H. Reeta, P. Gupta, and Y. K. Gupta. 2010. "Protective effect of curcumin against seizures and cognitive impairment in a pentylenetetrazole-kindled epileptic rat model." Life Sciences 87(19–22): 596–603. https://doi.org/10.1016/j.lfs.2010.09.006.
38.Yang, J., S. Song, J. Li, and T. Liang. 2014. "Neuroprotective effect of curcumin on hippocampal injury in 6-OHDA-induced Parkinson's disease rat." Pathology Research and Practice 210(6): 357–362. https://doi.org/10.1016/j.prp.2014.02.005.
39.Ejaz, A., D. Wu, P. Kwan, and M. Meydani. 2009. "Curcumin inhibits adipogenesis in 3T3-L1 adipocytes and angiogenesis and obesity in C57/BL mice." Journal of Nutrition 139(5): 919–925. https://doi.org/10.3945/jn.108.100966.
40.Prakash, P., A. Misra, W. R. Surin, M. Jain, R. S. Bhatta, R. Pal, K. Raj, M. K. Barthwal, and M. Dikshit. 2011. "Anti-platelet effects of Curcuma oil in experimental models of myocardial ischemia-reperfusion and thrombosis." Thrombosis Research 127(2): 111–118. https://doi.org/10.1016/j.thromres.2010.11.007.
41.Srivastava, R., M. Dikshit, R. C. Srimal, and B. N. Dhawan. 1985. "Anti-thrombotic effect of curcumin." Thrombosis Research 40(3): 413–417. https://doi.org/10.1016/0049-3848(85)90276-2.

42.Dohare, P., P. Garg, U. Sharma, N. R. Jagannathan, and M. Ray. 2008. "Neuroprotective efficacy and therapeutic window of curcuma oil: In rat embolic stroke model." BMC Complementary and Alternative Medicine 8: 55. https://doi.org/10.1186/1472-6882-8-55.
43.Dohare, P., S. Varma, and M. Ray. 2008. "Curcuma oil modulates the nitric oxide system response to cerebral ischemia/reperfusion injury." Nitric Oxide 19(1): 1–11. https://doi.org/10.1016/j.niox.2008.04.020.