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## PHYTOCHEMICAL INNOVATIONS AND THEIR THERAPEUTIC ROLE IN NEURODEGENERATIVE DISORDERS

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**Abstract.** Neurodegenerative disorders such as Alzheimer's disease (AD), Parkinson's disease (PD), and Huntington's disease (HD) are progressive neurological conditions associated with cognitive decline, neuronal loss, and impaired quality of life. The increasing prevalence of these disorders and the limitations of existing therapeutic options have encouraged exploration of medicinal plants as alternative neuroprotective agents. The objective of this study is to examine current trends in medicinal plant research and evaluate their therapeutic relevance in neurodegenerative disorders.

The methodology involved a narrative review and scientific evaluation of published literature focused on medicinal plants, phytochemicals, ethnopharmacological evidence, and molecular mechanisms associated with neuroprotection. Data from recent studies were analyzed to identify major bioactive compounds and their mechanisms of action.

The findings indicate that medicinal plants and plant-derived compounds demonstrate significant neuroprotective activities through antioxidant, anti-inflammatory, anti-apoptotic, and signaling pathway modulation mechanisms. Bioactive constituents including flavonoids, polyphenols, alkaloids, and terpenoids have shown the ability to regulate oxidative stress, mitochondrial dysfunction, protein aggregation, and neuroinflammation. Several medicinal plants including *Bacopa monnieri*, *Ginkgo biloba*, *Panax ginseng*, and *Centella asiatica* have exhibited promising therapeutic outcomes in experimental and preclinical studies.

In conclusion, medicinal plant research offers a promising direction for developing safer and multi-target therapeutic strategies for neurodegenerative disorders. Integration of traditional medicinal knowledge with modern pharmacological approaches may support future advancements in neuroprotective drug discovery.

**Keywords:** medicinal plants; neurodegenerative disorders; neuroprotection; phytochemicals; oxidative stress; ethnopharmacology; Alzheimer's disease

**Introduction.** Neurodegenerative disorders constitute a major public health concern due to their chronic progression and increasing global burden. Diseases including Alzheimer's disease, Parkinson's disease, and Huntington's disease are characterized by neuronal degeneration leading to impairment of memory, cognition, movement, and behavioral functions. Current therapeutic interventions are largely symptomatic and do not effectively prevent disease progression.

Medicinal plants have been utilized for centuries in traditional healthcare systems and continue to provide valuable sources for modern pharmaceutical development. Recent scientific interest has focused on identifying bioactive compounds capable of targeting multiple pathological pathways involved in neurodegeneration. Advances in ethnopharmacology, molecular pharmacology, and phytochemistry have accelerated the discovery of natural neuroprotective agents.

The scientific novelty of this work lies in summarizing emerging trends in medicinal plant research with emphasis on their mechanisms of action and therapeutic potential in neurodegenerative diseases.

**Research Methodology.** This work was conducted through a literature-based scientific review approach. Relevant peer-reviewed articles, review papers, and ethnopharmacological studies concerning medicinal plants and neurodegenerative disorders were evaluated.

Selection criteria included studies focusing on natural products with demonstrated neuroprotective mechanisms, including antioxidant activity, regulation of inflammatory mediators, modulation of neurotransmitter systems, and protection against neuronal apoptosis.

The collected information was systematically analyzed to identify common therapeutic pathways and recent developments in medicinal plant-based neuroprotection.

**Results and Discussion.** Analysis of recent research demonstrated that medicinal plants exert neuroprotective effects through multiple biological mechanisms. Oxidative stress and chronic neuroinflammation were identified as major contributors to neuronal degeneration. Plant-derived compounds showed effectiveness in reducing reactive oxygen species (ROS), suppressing inflammatory cytokines, and preserving neuronal integrity.

Among the investigated medicinal plants, *Ginkgo biloba* demonstrated antioxidant and cognition-supporting activities, while *Bacopa monnieri* exhibited protective effects through modulation of oxidative stress pathways and enhancement of neuronal signaling. *Panax ginseng* and *Centella asiatica* showed anti-inflammatory and mitochondrial protective actions.

Emerging trends indicate increased application of advanced technologies such as metabolomics, molecular docking, artificial intelligence-assisted screening, and nanotechnology to improve identification and delivery of plant-derived neuroprotective agents. Despite encouraging outcomes, challenges including standardization, dosage