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Clinical insights into catechin–based nanomedicine: a review of therapeutic potential in neurodegenerative diseases

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Abstract

Neurodegenerative diseases (NDs) such as Alzheimer's, Parkinson's, and Huntington's diseases are characterized by progressive neuronal loss, oxidative stress, neuroinflammation, and cognitive decline. The most prevalent and bioactive catechin in green tea, epigallocatechin-3-gallate (EGCG), has shown promise as a neuroprotective agent because of its many biological properties. The review discusses the potential of EGCG in combating neurodegeneration and cognitive impairments through

antioxidant benefits and signaling pathways. Recent advancements in structural analogs, liposomal encapsulation, and nanoformulations have shown potential in improving pharmacokinetics. High dosage safety issues and inter-individual response variability remain significant challenges in the field of medicine. The review emphasizes the importance of structured clinical trials, formulation uniformity, biomarker-guided monitoring, and customized therapy approaches to fully realize EGCG's potential as a neuroprotective drug. EGCG improves autophagic clearance, reduces tau hyperphosphorylation, and inhibits amyloid-beta aggregation, aiding in neuroprotective properties. Early clinical trials suggest it can be used as an adjuvant therapy, and recent advancements in formulation and delivery techniques are promising.

Keywords: Cognitive impairments; Epigallocatechin-3-gallate; Neurodegenerative diseases; Neuroprotection; Oxidative stress.

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