

Mini Review

Quercetin as a Potential Therapeutic Agent for Multiple Sclerosis: A Mini Review

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Abstract

Multiple Sclerosis (MS) is a chronic autoimmune and neurodegenerative disorder characterized by inflammation, demyelination, and progressive neuronal damage within the central nervous system (CNS). The disease affects millions of people worldwide and is associated with motor dysfunction, sensory impairment, cognitive decline, and reduced quality of life. Although several disease-modifying therapies are available, their long-term efficacy is limited by adverse effects, high costs, and incomplete prevention of neurodegeneration. Therefore, there is growing interest in identifying naturally derived compounds with anti-inflammatory and neuroprotective properties that may complement existing therapies.

Keywords: Quercetin, Central nervous system, Autoimmune and neurodegenerative disorder

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Introduction

Quercetin, a naturally occurring flavonoid found in fruits, vegetables, tea, and medicinal plants, has attracted considerable attention because of its diverse biological activities. Numerous studies have demonstrated that quercetin exhibits potent antioxidant, anti-inflammatory, antiviral, anticancer, and immunomodulatory effects. Its antioxidant activity is primarily attributed to its ability to scavenge reactive oxygen species (ROS), inhibit lipid peroxidation, and enhance endogenous antioxidant defense systems. These properties are particularly relevant to MS, where oxidative stress plays a critical role in neuronal injury and disease progression.

Recent evidence suggests that quercetin can modulate immune responses by suppressing the production of pro-inflammatory cytokines, including tumor necrosis factor- α (TNF- α), interleukin-1 β (IL-1 β), and interleukin-6 (IL-6). Furthermore, quercetin inhibits the activation of microglia and astrocytes, which are major contributors to neuroinflammation in MS. Studies have also reported that quercetin regulates signaling pathways such as NF- κ B, JAK/STAT, and MAPK, thereby reducing inflammatory responses and immune-mediated tissue damage.

In addition to its immunomodulatory effects, quercetin has demonstrated significant neuroprotective and regenerative potential. Experimental studies have shown that quercetin promotes neuronal survival, stimulates neurite outgrowth, enhances the differentiation of neuronal precursor cells, and protects oligodendrocytes from oxidative damage. These properties suggest

that quercetin may contribute not only to reducing inflammation but also to supporting remyelination and neural repair.

Experimental Autoimmune Encephalomyelitis (EAE) is the most widely used animal model for studying MS because it reproduces many of the pathological and clinical features of the disease. Several investigations using EAE models have demonstrated that quercetin treatment reduces disease severity, suppresses inflammatory cell infiltration, and improves neurological outcomes. These findings indicate that quercetin may serve as a promising adjunctive therapeutic agent for autoimmune demyelinating disorders.

This mini-review summarizes the current understanding of the molecular mechanisms underlying the anti-inflammatory, antioxidant, and neuroprotective effects of quercetin and highlights its therapeutic potential in the management of Multiple Sclerosis and related neuroinflammatory diseases.

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