

A Pharmacological Look at Neuroinflammation: Focusing on the Natural Remedies

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Abstract

Neuroinflammation (NI) is defined as a condition in which neurons undergo inflammatory processes, which can lead to transient and permanent functional disruptions in neurons. These disruptions can initiate various neuropsychiatric conditions such as Alzheimer's and Parkinson's diseases. Significant findings have been reported regarding the underlying conditions such as infections and oxidative stress that contribute to neuronal inflammation in recent years. As such, studies have introduced many valuable approaches to alleviate NI and its subsequent medical conditions. Pharmacological approaches have long been of interest to patients and therapists, particularly in the context of NI, where significant achievements have been made. Scrutinizing the literature indicates that natural remedies have gained considerable attention among researchers in this regard. Therefore, the current review was conducted to collect and classify relevant studies to provide reliable information on the role of natural remedies in NI management.

Keywords: Neuroinflammation, Brain, Central nervous system, Natural remedies

Introduction

Various exogenous and endogenous factors may disrupt the physiological homeostasis of the central nervous system (CNS). The body's response to such disruption involves a physiological mechanism called neuroinflammation (NI).¹ NI which is defined as an inflammation occurring in the neurons is not necessarily a positive and helpful biological event. Many natural defenses have been reported to be activated against the harmful effects of NI.² NI can be triggered by various physiological processes, including systemic inflammations, obesity, trauma, autoimmune responses, and aging (Figure 1). Initially, inflammation in the CNS may help neurons recover their normal physiology. However, complications mostly happen in the chronic stage when neurons tolerate prolonged inflammation. At this stage, various CNS disorders such as depression, multiple sclerosis, and Alzheimer's and Parkinson's diseases may be triggered.³

On the other hand, the literature has extensively discussed the correlation between oxidative stress and NI, which can result in anxiety and depression.⁴ Interestingly, oxidative damage has been shown to play a role in cell death and dysfunction across numerous pathologies. Moreover, repair systems and endogenous antioxidant mechanisms are crucial factors against the pathogenesis of many diseases.⁵ Given that free radicals can damage

DNA structures, the protective effects of antioxidants on neurons seem to be reasonable.^{6,7}

Recently, the approach of using natural compounds to treat neurological disorders has expanded.⁸⁻¹³ In this regard, the alleviating effect of various herbs with anti-neuroinflammatory properties on different medical conditions has been tested and reported.¹⁴⁻¹⁶ On the other hand, nutritionists have recognized the benefits of diets with antioxidant and anti-inflammatory properties for brain health; however, the detailed cellular and molecular mechanisms are still under investigation.^{17,18} These statements underscore the need for a closer look at NI, with a particular focus on natural treatments. (Figure 2) Therefore, the present study was designed to address these concerns. In the following, some natural agents found to be more effective in alleviating NI will be listed and discussed (Table 1).

Turmeric

Turmeric (*Curcuma longa*) is a medicinal plant that is categorized as a member of the ginger family. The plant is extensively grown and consumed worldwide, particularly in southern and southwestern Asia.^{31,32} Antineoplastic, antimicrobial, antioxidant, and anti-inflammatory potential of turmeric has been tested and reported.^{33,34} Notably, curcumin, the major constituent of

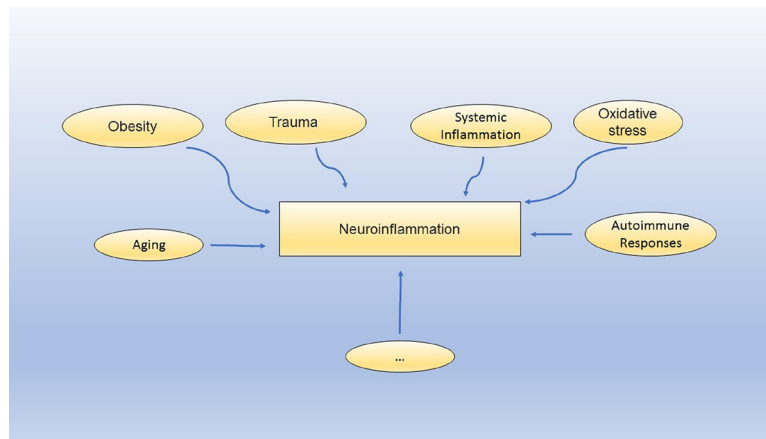


Figure 1. Some Underlying Causes of Neuroinflammation

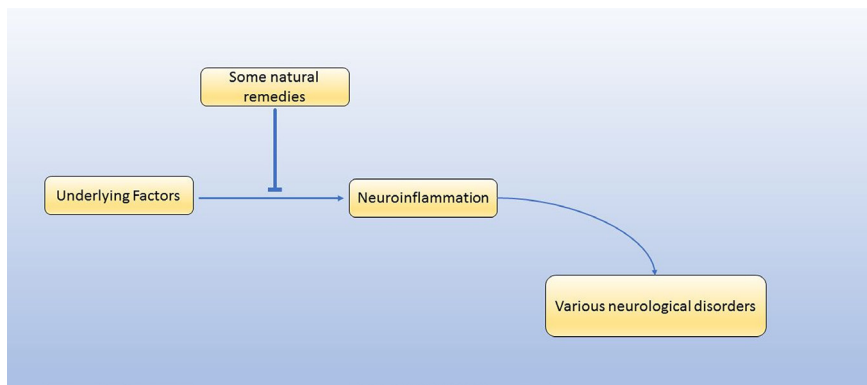


Figure 2. Effects of Natural Remedies on Neuroinflammation and Subsequently Neurological Disorders

Table 1. Some Natural Remedies Alleviating Neuroinflammation

Agent	Main Findings	Ref.
Turmeric	It has been shown that turmeric can modulate microglia and astrocytes, subsequently reducing NI.	19
Coconut oil	While many other oils have been shown to induce NI, this effect was not observed following the administration of coconut oil.	20
Red grape	Various studies have indicated that natural compounds found in red grape have beneficial effects on NI reduction.	21-29
Ginseng	Reviewing the literature shows that red ginseng may alleviate NI and subsequently neurodegeneration.	30

Note. NI: Neuroinflammation.

turmeric,³⁵ has been shown to effectively reduce NI and its negative consequences. Studies suggest that curcumin may modulate microglia and astrocytes, which can be an underlying mechanism.¹⁹

Coconut Oil

Coconut oil, widely used in food industries,³⁶ is a popular food ingredient in the world, especially in South Asia. Its antimicrobial, antidiabetic, antihepatosteatotic, anticancer, and hypocholesterolemic effects have been reported, along with its anti-inflammatory effects.³⁷ Animal models have demonstrated that while high-fat diets significantly induce NI, coconut oil consumption did

not cause such consequences.²⁰

Red Grape

Red grapes contain numerous beneficial chemical compounds, with resveratrol being one of the most famous.^{38,39} Antioxidant, anti-aging, and anti-cancer effects of resveratrol are well-documented and repeatedly reported.²¹ Moreover, the beneficial effects of resveratrol on NI have been highlighted in numerous studies. Various pathways and mechanisms have been proposed for the observed effects, each of which can be a target for future studies.²²⁻²⁹

Ginseng

Ginseng includes several species, each growing in particular regions, exerting exclusive pharmacological effects.⁴⁰ Recent data suggests that red ginseng may regulate NI and, subsequently, neurodegeneration.³⁰

Conclusion

This review aimed to gather a list of natural compounds capable of alleviating NI and its relevant clinical conditions. The literature review indicates that timely and appropriate treatment of NI can prevent many negative consequences. As discussed, the approach to natural treatments in this regard has led to valuable findings, though further preclinical and clinical studies may be required to ensure

the safe and efficient administration of these agents.

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Authors' Contribution

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Competing Interests

None to declare.

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