

Brewing Brain Health: The Neuroprotective Wonders of Coffee

P.M. Usha Nandhini

Research scholar, Department of Postharvest Technology, Horticultural college and Research Institute, TNAU, Periyakulam- 625604.

Corresponding Author: babucac002@gmail.com

Abstract

Coffee is a complex bioactive beverage with strong neuroprotective qualities that may improve cognitive longevity and brain health. Packed with diterpenes, caffeine, and polyphenols, it lowers neuroinflammation, counteracts oxidative stress, and promotes neuroplasticity. According to studies, coffee may lower the risk of neurodegenerative illnesses including Parkinson's and Alzheimer's via influencing amyloid-beta clearance and mitochondrial activity. Coffee's effects on neurotransmitter systems, especially those of dopamine and adenosine, can also improve mood and cognitive function. Coffee shows promise as a dietary ally in preventing age-related brain loss and promoting mental sharpness as a multidimensional cognitive enhancer.

Introduction

Coffee, a globally cherished beverage, has emerged as a powerhouse of bioactive compounds with promising neuroprotective potential. Beyond its role as a daily stimulant, coffee contains caffeine, chlorogenic acids, and polyphenols, which collectively exhibit profound effects on brain health. This review delves into the growing body of evidence linking coffee consumption to a reduced risk of neurodegenerative diseases, including Alzheimer's and Parkinson's. Caffeine, renowned for its adenosine receptor-blocking activity, enhances cognitive function, delays neuronal degeneration, and improves mood. Meanwhile, chlorogenic acids and polyphenols act as potent antioxidants, countering oxidative stress and inflammation key drivers of neurodegeneration. Epidemiological studies consistently reveal a U-shaped relationship between moderate coffee intake and a lower incidence of cognitive decline, highlighting an optimal range for consumption. Factors such as genetic predisposition, coffee preparation methods, and individual metabolic variations further influence its neuroprotective efficacy. Additionally, emerging research suggests that coffee may modulate brain-derived neurotrophic factor (BDNF) levels, enhance synaptic plasticity, and support mitochondrial function. While the evidence is compelling, gaps remain in understanding the precise molecular pathways and

long-term effects of coffee's bioactive. This review underscores coffee as a functional beverage with the potential to safeguard brain health, offering a scientifically grounded perspective on its role in combating cognitive aging and neurodegeneration.

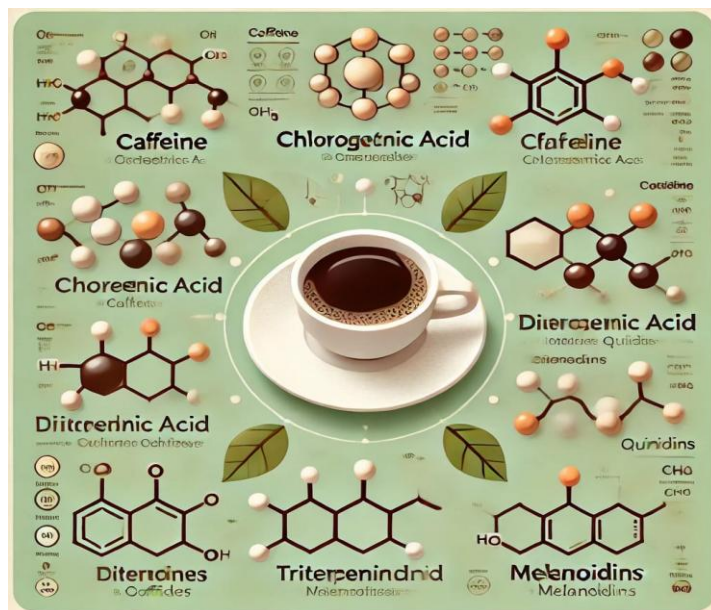


Fig.1 Bioactive compounds present in coffee

Neuroprotective effects of coffee bioactive compounds

Caffeine

Caffeine, a central nervous system stimulant, exerts neuroprotective effects primarily through adenosine receptor antagonism, enhancing dopaminergic and glutamatergic signaling. This promotes improved cognitive function, mood regulation, and neuroplasticity. Additionally, caffeine reduces oxidative stress and neuroinflammation, while enhancing mitochondrial efficiency, which collectively safeguards neuronal integrity. Studies suggest caffeine's regular consumption correlates with a lower risk of neurodegenerative disorders like Alzheimer's and Parkinson's, underscoring its therapeutic potential in brain health. According to Palacios *et al.*, men who drank at least two cups of coffee a day, which is equivalent to 274 mg of caffeine, were 50% less likely to develop Parkinson's disease than women who drank 3.2 cups of coffee, which is equivalent to 435 mg of caffeine.

Chlorogenic acid

Chlorogenic acid, a polyphenolic compound in coffee, exhibits neuroprotective effects through its potent antioxidant and anti-inflammatory properties. It scavenges free radicals, reducing oxidative stress that damages neurons. By modulating key signalling pathways, chlorogenic acid helps reduce neuroinflammation and enhances mitochondrial function, supporting neuronal survival. Additionally, it may regulate neurotrophic factors, promoting neuroplasticity and cognitive function.

Caffeic acid

Caffeic acid, a bioactive compound in coffee, exerts neuroprotective effects through its antioxidant and anti-inflammatory properties. By scavenging reactive oxygen species, it reduces oxidative stress, a key factor in neuronal damage. Caffeic acid also modulates inflammatory pathways, lowering neuroinflammation and protecting the blood-brain barrier. Additionally, it enhances neurotrophic factor expression, promoting neurogenesis and synaptic plasticity, which contribute to cognitive function and may help prevent neurodegenerative diseases like Alzheimer's and Parkinson's.

Trigonelline

Trigonelline, an alkaloid found in coffee, demonstrates neuroprotective effects through its antioxidant, anti-inflammatory, and neurotrophic properties. It scavenges free radicals, reducing oxidative stress, and modulates inflammatory pathways, alleviating neuroinflammation. Trigonelline also promotes the expression of brain-derived neurotrophic factor (BDNF), enhancing neurogenesis and synaptic plasticity. These mechanisms support neuronal survival and cognitive function, making trigonelline a promising compound for protecting against neurodegenerative diseases and improving overall brain health.

Kahweol and Cafestol

Two coffee-specific diterpenes, kahweol and cafestol, are found in unfiltered coffees including espresso, Turkish coffee, French press coffee, and

Scandinavian-style boiling coffee. Given its strong antioxidant and cytoprotective qualities, kahweol ought to have neuroprotective effects as well. Cafestol was shown to have anti-inflammatory and antioxidant properties, just like kahweol. According to other research, cafestol may boost HO-1 expression, stop excessive ROS production, activate the Nrf2/ARE signaling pathway, and guard against oxidative DNA damage. Its possible neuroprotective function could be influenced by all of these factors.

Conclusion

Coffee is not just a morning drink, but a potent neuroprotective beverage, packed with bioactive compounds like caffeine, chlorogenic acid, caffeic acid, and trigonelline that work synergistically to support brain health. These compounds combat oxidative stress, reduce neuroinflammation, and enhance neuroplasticity, providing significant protection against cognitive decline and neurodegenerative diseases. Regular, moderate coffee consumption has been linked to improved cognitive function, mood enhancement, and even longevity. However, like any powerful stimulant, the key lies in moderation. Excessive coffee intake may lead to negative effects like sleep disturbances or anxiety. When consumed in appropriate amounts, coffee can be an essential ally in brewing brain health and cognitive vitality, making it a wise and effective part of a healthy lifestyle.

Reference

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