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Spirulina: A promising opportunity to overcome neuropathic pain challenges in chronic kidney disease patients

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To Editor,

Neuropathic pain management presents significant challenges due to its multifactorial etiology and complex underlying pathways. This is particularly evident in patients with chronic kidney disease (CKD), who require meticulous drug selection and dose adjustment to avoid further renal compromise. Peripheral polyneuropathy is the most prevalent complication associated with CKD, affecting over 60% of patients and contributing to disability and diminished quality of life.¹ First-line treatments for neuropathic pain syndromes, including tricyclic antidepressants, gabapentinoids, and serotonin-norepinephrine reuptake inhibitors, are commonly recommended. However, the inherent complexity of neuropathic pain and the poor tolerability of these medications in CKD patients underscore the growing need for novel therapeutic agents.²

Spirulina, a filamentous cyanobacterium, is rich in bioactive compounds such as phycocyanin, polyphenols, β -carotene, γ -linolenic acid, and antioxidant enzymes, including superoxide dismutase (SOD) and catalase. These constituents exhibit potent anti-inflammatory and antioxidant effects by inhibiting NF- κ B and COX-2 signaling pathways and reducing inflammatory cytokines like TNF- α and IL-6.³ The U.S. Food and Drug Administration (FDA) recognizes Spirulina as a safe dietary supplement.⁴ Nonetheless, caution is warranted regarding its potential interactions with cytochrome P450 isoenzymes.⁵

Emerging evidence suggests that Spirulina may offer benefits in ameliorating neuropathy. Preclinical studies have demonstrated its positive effects on diabetic neuropathy, sciatic neuropathic pain, and chemotherapy-induced neuropathy.⁶⁻⁸ Notably, dysregulation of

the Nrf2 pathway and oxidative stress are central to CKD progression and its complications. From a neuroprotective perspective, Spirulina activates Nrf2/HO-1 and BDNF/CREB signaling pathways, serving as a potential therapeutic target for neuropathic pain management by enhancing antioxidant defense, neuronal survival, and neurogenesis. It also suppresses microglial activation and inflammatory cytokines, thereby mitigating neuroinflammation and protecting neurons from oxidative stress-induced apoptosis.⁹⁻¹²

Numerous studies have further elucidated the nephroprotective properties of Spirulina. Its efficacy and safety in CKD patients have been substantiated.^{13,14} Specifically, Spirulina significantly reduces oxidative stress markers such as malondialdehyde (MDA) and reactive oxygen species (ROS), boosts antioxidant enzyme activity in renal tissue, inhibits inflammatory mediators including TNF- α , IL-6, and TGF- β implicated in renal inflammation and fibrosis, and modulates fibrosis and apoptosis pathways to protect against CKD progression.¹⁵

Together, these molecular mechanisms support spirulina's dual neuro- and nephroprotection potential in CKD patients experiencing neuropathic pain. Although it has not yet garnered widespread clinical attention, Spirulina's valuable nephroprotective and neuroprotective attributes merit further investigation as a novel, efficacious complementary treatment for neuropathy in this population. Robust validation through targeted clinical trials is imperative. We posit that Spirulina represents a promising avenue to enhance the quality of life for these patients. Your journal would lead innovative research by highlighting this strategy to address this pressing clinical challenge.

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Study Highlights

- Neuropathic pain is a complex challenge in chronic kidney disease (CKD) patients.
- Existing treatments often have limited efficacy and tolerance issues.
- Spirulina exhibits anti-inflammatory and antioxidant properties.
- This study highlights spirulina's dual neuroprotective and nephroprotective potentials in CKD patients.
- Molecular mechanisms include modulation of inflammatory cytokines and oxidative stress.
- Spirulina may provide a novel complementary treatment to improve quality of life in CKD patients.

Competing Interests

The author declares that she has no conflict of interest.

Ethical Approval

Not applicable.

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