INSIGHTS@NIFS

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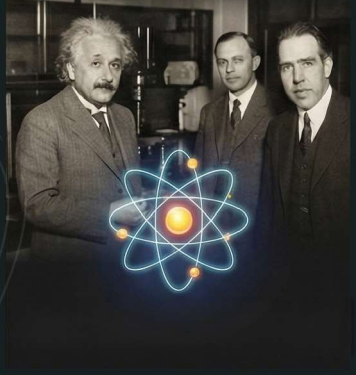
100 Years of Quantum



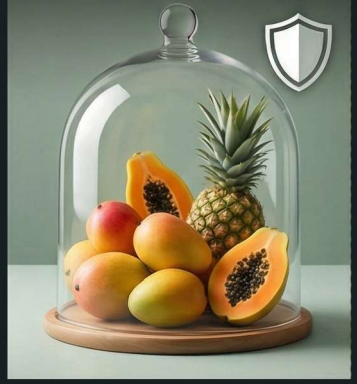
Microplastics: Sri Lanka's Invisible Threat

Banana Stems: The Hidden Superfood

The Twin Diet: A Sri Lankan Study

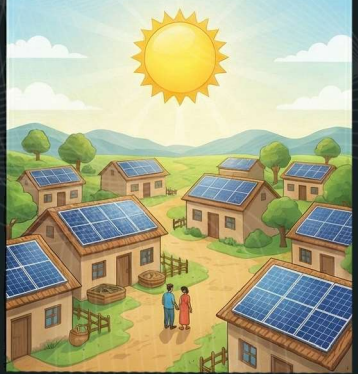
Duckweed: The Future of Protein

Protecting Our Tropical Fruits



Where Superbugs Are Born

The Solar Village Revolution



Ginger: More Than Just Spice

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES - SRI LANKA

Zingiber officinale: More Than Spice – A Bioactive Powerhouse

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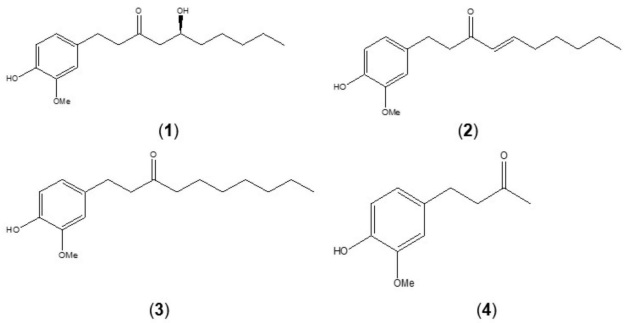
Zingiber officinale, commonly known as ginger, is a widely utilized culinary spice and medicinal plant with a long history of use in traditional medicine, owing to its diverse pharmacological properties. From Ayurvedic medicine to Chinese traditional medicine, ginger was recommended for use in control of cold, nausea, gastrointestinal problems, and even pain. It is particularly noted for its immunomodulatory effects. The pharmacological versatility of ginger can be attributed to its diverse array of phytochemicals. The major bioactive compounds include: gingerol (1), shogaol (2), paradol (3), and zingerone (4). These compounds possess significant anti-inflammatory, antioxidant, and antimicrobial activities. These activities contribute to support and strengthening of the immune system. The gingerols contain anti-inflammatory abilities, which act against free radical damage. The shogaols produced by ginger when dried or heated, may be even stronger to act against germs and cancer at times. Paradols contain additional antioxidant actions. The zingerone is what makes ginger smell and aids in metabolism.



Ginger exhibits broad-spectrum of antimicrobial activities. Its extracts have demonstrated efficacy against a variety of pathogenic microorganisms, including bacteria, fungi, and viruses. These antimicrobial effects are reported to reduce pathogen burden, thereby alleviating stress on the immune system and enhancing its efficiency. This dual role direct pathogen inhibition and immune support highlights ginger's value as an immunomodulatory agent. In addition, ginger possesses well-documented anti-inflammatory, analgesic, and anti-edematous properties. Animal studies have revealed its capability to reduce inflammation and edema in models of arthritis while clinical trials have confirmed its effectiveness in alleviating pain. These effects are largely attributed to the inhibition of pro-inflammatory mediators such as cytokines and prostaglandins, contributing to improved immune homeostasis and prevention of chronic inflammatory conditions. Furthermore, ginger demonstrates promising cytotoxic effects against various cancer cell lines, indicating potential application in oncology as a plant-based chemotherapeutic. Its active constituents have shown the ability to inhibit cancer cell proliferation, inducing apoptosis, and suppressing angiogenesis. Ginger is also recognized for its efficacy in managing nausea and vomiting, particularly during pregnancy and chemotherapy-induced cases. Numerous clinical and preclinical investigations have supported its use as a safe and effective adjuvant in these contexts.

Extensive research done in the past has demonstrated that ginger possesses potent antioxidant activity, contributing to cellular protection as well as the enhancement of immune system function. Ginger exerts its antioxidant effects primarily through the neutralization of free radicals. Key bioactive constituents such as gingerol and zingerone play a central role in this process by directly scavenging reactive oxygen species and enhancing the activity of endogenous antioxidant enzymes. The essential oil of ginger has been shown to increase the level of superoxide dismutase, glutathione peroxidase and glutathione-s-transferase in liver, showing the role of ginger essential oil in protecting the cells from extracellular deleterious radicals, by increasing the serum and liver antioxidant enzymes. This enzymatic upregulation underscores ginger's ability to bolster systemic antioxidant defenses and its protective effect on tissues, particularly hepatic cells. Among these, the principal bioactive component, gingerol, has been shown to reduce inflammation by inhibiting the release of pro-inflammatory cytokines, thereby promoting immune homeostasis and helping to prevent chronic inflammatory conditions.

Collectively, these compounds exhibit synergistic interactions, which contribute to their broad spectrum of biological activities. Depending on the concentration, environmental conditions, as well as the specific biological target, different subsets of compounds may dominate, thereby shifting the overall response toward either inhibitory or stimulatory effects. In addition, it has wider implications for existing sustainability effort and drug discovery processes. Plant compounds from ginger can act as substitutes where antibiotic resistance is a major issue. The bioactive compounds of ginger are amendable for creating novel antimicrobial agents or being transformed into anti-inflammatory drugs having fewer side effects.

Conclusions

Given these pharmacological properties, ginger is a valuable dietary component, especially during time periods of increased susceptibility to infections. It can be consumed in various forms such as fresh, dried, powdered, or as an extract offering a safe and natural approach to support immune health. The rich composition of bioactive compounds in ginger might provide significant benefits for immune function through its antioxidant, anti-inflammatory, and antimicrobial effects, as well as its capacity to enhance immune cell activity. Regular consumption of ginger may contribute to improved overall health and greater resilience against infections. The characteristic warmth associated with ginger is not merely a sensory attribute but a reflection of its complex phytochemical composition and bioactive functionality. This insight transcends culinary interest, highlighting the scientific importance of re-evaluating traditional remedies through the lens of modern pharmacological research. As such, the future of integrative medicine may increasingly rely on the therapeutic potential of natural products like ginger, once confined to traditional use, now recognized as candidates for evidence-based clinical application.