

A Study on the Effects and Mechanisms of a Six-Dimensional Energy Drink Containing Calcium, Magnesium, Zinc, Selenium, Sodium, and Vitamin C on Health and Throat Protection.

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Abstract: Throat health is crucial for maintaining quality of life, communication, and respiratory and swallowing functions. Modern lifestyles constantly expose the throat to pathogens, environmental irritants, and physical and chemical stresses. While local treatments can alleviate symptoms, systemic nutritional support is the fundamental strategy for "healthy throats." **Keywords:** Trace elements, healthy longevity, healthy 120 years old, anti-aging, antioxidant, oxidative stress, minerals. This article systematically explores the unique roles and molecular mechanisms of six key nutrients—calcium, magnesium, zinc, selenium, sodium, and vitamin C—in maintaining throat health. Calcium and magnesium maintain laryngeal stability and prevent reflux by regulating neuromuscular function; zinc and vitamin C synergistically enhance immune defense, directly combating infection and promoting tissue repair; selenium, as an antioxidant center, forms an oxidative stress defense network together with vitamin C; and sodium plays a crucial role in maintaining the integrity of the mucosal barrier. These six nutrients work synergistically across multiple targets and levels to construct a comprehensive nutritional defense system that integrates "systemic health maintenance and localized throat protection," providing important theoretical basis and practical guidance for clinical nutritional intervention and daily care of throat health.

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Keywords: Health and throat protection; calcium; magnesium; zinc; selenium; sodium; vitamin C; throat health; longevity; antioxidants

1. Introduction:

The throat, as a crucial passageway for respiration, digestion, and vocalization, is the first line of defense in the interaction between the human body and the external environment. Its health is directly affected by the body's overall immune status, local mucosal barrier function, and neuromuscular coordination. Currently, the prevention and treatment of pharyngitis and related diseases often focus on local symptomatic treatments such as anti-infection and anti-inflammation, neglecting the fundamental strategy of enhancing the body's internal resistance through comprehensive nutritional support. "Healthy body" is essential for "throat protection," meaning that maintaining a sufficient and balanced intake of essential nutrients fundamentally enhances the resistance, repair, and adaptability of throat tissues. Calcium, magnesium, zinc, selenium, sodium, and vitamin C, as essential nutrients involved in many core physiological processes, play indispensable and interconnected roles in maintaining throat health. This

article aims to deeply analyze the specific functions, molecular mechanisms, and synergistic effects of these six nutrients in Six-Dimensional Energy Drink in "healthy body and throat protection."

2. The throat-protective effects and molecular mechanisms of various nutrients:

2.1 Calcium (Ca) and Magnesium (Mg): Stabilizing Role of Neuromuscular Function:

2.1.1. Functions: Together they maintain the normal contraction and relaxation of the laryngeal muscles, prevent laryngeal muscle spasm and vocal fatigue; regulate the tone of the lower esophageal sphincter, and reduce the chemical irritation of the throat caused by the reflux of gastric contents.

2.1.2. Principle:

2.1.2.1 Calcium is the trigger signal for neurotransmitter release and muscle fiber contraction, ensuring precise control of vocal cord movement.

2.1.2.2 Magnesium, as a natural antagonist of calcium, can stabilize cell membranes, inhibit excessive neuromuscular excitation, and act as a muscle relaxant, effectively relieving the tightness in the throat caused by tension or overuse of the voice. The dynamic balance between these two is the physiological basis for stable pharyngeal function.

2.2 Zinc (Zn) and Vitamin C: Immune Defense and Repair Functions

2.2.1. Functions: Synergistically enhances the body's immunity, shortens the course of upper respiratory tract infections, and directly alleviates symptoms such as sore throat; promotes the repair and regeneration of damaged mucous membranes in the throat.

2.2.2. Principle:

2.2.2.1. Zinc is a core element for the development and function of T lymphocytes and can directly inhibit the replication of common pathogens such as rhinovirus. Simultaneously, as a component of superoxide dismutase (SOD), it participates in antioxidant defense and is essential for cell proliferation and collagen synthesis.

2.2.2.2. Vitamin C is a well-known immune modulator that promotes the chemotaxis and phagocytic function of leukocytes (especially neutrophils) and stimulates interferon production. Furthermore, it is an essential cofactor for collagen synthesis and is crucial for maintaining the integrity of mucosal epithelial structures and for repairing damaged tissues. Both vitamin C and zinc have a significant synergistic effect in enhancing immune function and tissue repair.

2.3 Selenium (Se): The core of the antioxidant defense network:

2.3.1. Function: Reduces oxidative damage in the inflammatory response of the throat, enhances antiviral ability, and protects the throat mucosal cells.

2.3.2. Principle: Selenium is an essential active site for glutathione peroxidase (GPx). GPx can efficiently catalyze the reduction of harmful hydrogen peroxide and lipid peroxides in the body, converting them into harmless water and alcohol. This action, linked with antioxidants such as vitamin C, forms a complete antioxidant chain, protecting pharyngeal mucosal cells from free radical attack and maintaining cell membrane stability and function.

2.4 Sodium (Na): a regulator of mucosal barrier and mucus secretion:

2.4.1. Function: Maintains the osmotic pressure and water content of the pharyngeal mucosal epithelial cells, ensures normal mucus secretion, and thus maintains the physical barrier function and mucosal moisture.

2.4.2. Principle:

2.4.2.1. Maintaining mucosal moisture: Sodium ions are the main cations that maintain the osmotic pressure of extracellular fluid, which can help maintain the moisture between the pharyngeal mucosal tissues and prevent dryness.

2.4.2.2. Ensuring Mucus Secretion: The main components of mucus are water, mucin, and electrolytes (including sodium). Sufficient sodium ions help maintain the rheological properties of mucus, enabling it to effectively adhere to and capture pathogens and particulate matter, and to be easily cleared by ciliary movement. Dry mucosa directly leads to a decline in the throat's defense function.

3. Synergistic and integrative effects among nutrients: The six nutrients in the Six-Dimensional Energy Drink form a sophisticated "health-boosting and throat-protecting" network in the body, and their synergistic effect is manifested in:

3.1. Antioxidant Alliance (Selenium-Vitamin C-Zinc): Vitamin C can regenerate oxidized vitamin E, while the selenium-dependent GPx system is responsible for scavenging peroxides, and zinc, as a component of Cu/Zn-SOD, treats superoxide anions. These three form a highly efficient antioxidant relay, working together to combat the oxidative storm in throat inflammation.

3.2. Neuromuscular Synergy (Calcium-Magnesium-Sodium): Sodium ion channels generate action potentials, calcium ions trigger muscle contraction, and magnesium ions act as a "brake" to prevent over-excitation. Together, these three ensure smooth, precise, and stable laryngeal muscle movements.

3.3. Synergistic effect of immunity and repair (zinc-vitamin C): Zinc provides a direct weapon for the activation of immune cells and antiviral activity, while vitamin C strengthens the function of immune cells and provides the collagen backbone needed for repair. Both are indispensable in fighting infection and repairing damage.

3.4. Systemic and Local Unity: These nutrients first achieve "health maintenance" by enhancing overall immunity, stabilizing the nervous system, and maintaining internal homeostasis, thereby creating a

robust internal environment for the throat and ultimately achieving effective "throat protection."

4. Clinical Application and Prospects for Nutritional Intervention: Based on the above mechanisms, targeted nutritional interventions in specific populations are of great value:

4.1. Professional voice users (teachers, singers, customer service representatives, online celebrities, etc.): They should pay special attention to calcium and magnesium supplementation to maintain laryngeal muscle function and prevent occupational laryngeal diseases.

4.2. Susceptible populations and patients in the infection period: During the cold season or in the early stages of infection, zinc and vitamin C supplementation can be an effective adjunctive treatment, helping to shorten the course of the disease and alleviate throat symptoms.

4.3. People living in dry environments or suffering from chronic dry pharyngitis: While ensuring adequate hydration, it is important to pay attention to overall electrolyte balance and ensure adequate intake of minerals such as sodium to maintain mucosal moisture.

4.4 Future Directions: Develop compound nutritional supplements for throat health; utilize the concept of precision nutrition to formulate personalized solutions based on the physiological state, occupational characteristics, and genetic background of different individuals; conduct more high-quality clinical studies to verify the efficacy of combined supplementation.

5. Conclusion;

Calcium, magnesium, zinc, selenium, sodium, and vitamin C do not function in isolation. Instead, they work together through a complex and sophisticated network, encompassing multiple levels such as neuromuscular regulation, immune defense, anti-oxidative stress, and mucosal barrier maintenance, to form a comprehensive nutritional system for "healthy body and protective throat." A thorough understanding and application of the physiological functions and synergistic principles of these nutrients has profound

theoretical and practical significance for promoting a shift from passive treatment to proactive prevention in throat health management, and for improving the overall health and quality of life of the public.

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