Analysis of Unique Properties of Rosemary Grapefruit Concentrate Powder

Rosemary Grapefruit Concentrate Powder is a natural composite functional powder produced through standardized processes—including targeted aqueous/alcoholic extraction, low-temperature concentration, and spray drying—using edible rosemary (leaves/tender stems) and grapefruit (peel/pulp) as raw materials. The product integrates the core active components of both materials, combining stable physicochemical adaptability with diverse biological functions. It not only overcomes the application limitations of single plant materials but also aligns with the "natural, clean, and high-efficiency" upgrade needs of the food, health product, and daily chemical industries through its "one-ingredient, multi-functional" nature. It provides enterprises with a core raw material solution for cost reduction, efficiency improvement, and value enhancement, empowering the development of high-value-added products.

I. Physicochemical Characteristics:

Balancing Technical Stability and Industrial Applicability

The product's physicochemical characteristics are determined synergistically by the inherent components of the raw materials and precise processing. Its key indicators fully comply with domestic and international food-grade and health supplement raw material standards such as GB 2760 and GB/T 30385. This ensures compositional stability and suitability for large-scale production and all formulation types, laying a solid foundation for commercial application.

1. **Appearance & Sensory Properties:** It appears as a light yellow to light green-yellow, loose powder, free from lumps and visible impurities. With a bulk density of 0.35–0.60 g/cm³ and a median particle size (D50) of 80–150 μm, it demonstrates excellent flowability and dispersibility, making it suitable for automated dosing and large-scale powder mixing processes, thereby enhancing production efficiency. Flavor-wise, it blends the herbal pungency of rosemary with the fresh, sweet fruitiness of grapefruit. The process has been optimized to remove bitter and astringent notes as well as irritants, resulting in high sensory acceptance. It can directly replace artificial flavors, helping products achieve a "natural flavor" label.
2. **Solubility & Dispersion Properties:** Possessing dual-phase (aqueous and lipid) compatibility, it dissolves easily in water and aqueous ethanol solutions containing up to 50% ethanol, forming a uniform system without precipitation upon dissolution. It also disperses uniformly in animal/vegetable oils and emulsions without clumping or oil separation. This characteristic allows application across all formulation types—liquid (beverages, serums), semi-solid (sauces, creams), and solid (compressed tablets, baking mixes)—without requiring additional dispersants, reducing formulation complexity and cost.
3. **Physical & Chemical Stability:** When stored sealed at ambient temperature (relative

humidity ≤60%), it remains loose for at least 6 months with no risk of moisture absorption or caking. Its physicochemical properties remain stable after secondary processing, reducing storage and production losses. It has a wide pH compatibility range (3.0–8.0) and can withstand mainstream processes such as high-temperature sterilization (≤121°C) and short-term baking (≤180°C) with an active ingredient retention rate ≥80%. This eliminates the need for modifications to existing production lines and significantly shortens the product development and adaptation cycle.

4. **Safety & Compliance Indicators:** The product features a low moisture content (≤5.0%), low ash content (≤3.0%), and high total solids (≥95.0%), indicating a high proportion of effective components and low susceptibility to microbial growth. Heavy metal and microbiological indicators fully meet standards. It contains no solvent residues or artificial synthetic additives, perfectly aligning with the "clean label" trend. This facilitates smooth market access approval and helps avoid compliance risks.

II. Functional Features:

Empowering Core Product Competitiveness through Diverse Activities

The product's functionality stems from the synergistic system of rosmarinic acid and carnosic acid (core components of rosemary) combined with naringin, D-limonene, and natural vitamin C (core components of grapefruit). There is no antagonism among components, allowing it to simultaneously meet three core product needs: preservation, flavor, and efficacy. This enables the creation of differentiated selling points for products across various industries.

1. **Dual-Phase Synergistic Antioxidant Activity:** Replaces chemical additives to upgrade natural attributes. The lipid-soluble carnosic acid and water-soluble rosmarinic acid form a dual-phase antioxidant system, enhanced by the recycling effect of vitamin C from grapefruit. The free radical scavenging efficiency far exceeds that of single raw materials, effectively inhibiting lipid peroxidation and component degradation. In commercial applications, it can replace chemical antioxidants like sodium benzoate and tert-butylhydroquinone (TBHQ), extending the shelf life of food and health products while strengthening the "natural and additive-free" marketing claim and enhancing product premium potential.
2. **Broad-Spectrum Natural Antimicrobial Activity:** Expands preservation scenarios, aligning with healthy consumption trends. Terpenoids and phenolics from rosemary inhibit both Gram-positive and Gram-negative bacteria, while D-limonene from grapefruit targets molds and yeasts. The combination results in a broader antimicrobial spectrum and stronger activity. It can serve as a natural preservative in products like meat products, pastries, and beverages, partially replacing chemical preservatives. This is suitable for the premium health food segment,

addressing consumer concerns about chemical additives and enhancing market acceptance.

3. **Flavor Modulation & Sensory Optimization:** Reduces costs and improves efficiency while enhancing consumer experience. The natural composite flavor can be added directly as a flavoring agent, enriching the flavor profile of baked goods, meat products, and functional beverages. It can also mask undesirable tastes like beany or bitter notes from protein powders and plant extracts, reducing the need for masking agents. This simplifies formulation design, improves product sensory acceptance, and lowers the consumer trial barrier.
4. **Metabolic Regulation & Nutritional Empowerment:** Targets the functional product sector, creating a core selling point. Naringin aids in regulating glucose and lipid metabolism and inhibiting fat accumulation. Rosmarinic acid helps alleviate oxidative stress and inflammation. Combined with natural vitamin C and flavonoids, it can empower the development of weight-loss meal replacements, sports nutrition foods, and sugar-control health supplements. This aligns with the current consumer trends of "healthy weight loss and precision nutrition," helping products achieve differentiated competition in the functional food market.
5. **Daily Chemical & Skincare Compatibility:** Unlocks natural skincare applications, expanding boundaries. Antioxidant components help delay skin aging, D-limonene provides gentle cleansing and soothing effects, and rosmarinic acid and naringin offer anti-inflammatory and redness-reducing benefits. Excellent water solubility makes it suitable for aqueous-phase formulations without greasiness. It can be widely used in toners, anti-aging serums, and natural cleansers, aiding daily chemical companies in developing "natural botanical extract" product lines and capturing market share in specific segments.

III. Unique Properties: Building Dual "Technical + Commercial" Competitive Barriers

The product's core advantages distinguishing it from single raw materials or ordinary composite powders lie in maximizing commercial value through technological innovation. It addresses industry pain points while creating multiple benefits for enterprises—cost reduction, efficiency improvement, and value addition—making it a cost-effective, multifunctional raw material choice.

1. **Aqueous-Lipid Dual-Phase Synergy:** Breaks application limitations and reduces compounding costs. Overcoming the scenario limitations of single rosemary (lipid-phase compatible) or grapefruit (aqueous-phase compatible) materials, one ingredient covers aqueous, lipid, and emulsion-based formulations. This eliminates the need for additional functional ingredients, reducing raw material procurement types, storage costs, and risks associated with multi-component compatibility. It significantly improves formulation R&D efficiency and production stability.
2. **Microencapsulation Process Empowerment:** Enhances bioavailability and strengthens

efficacy claims. The microencapsulated structure formed via low-temperature spray drying protects active ingredients from light, heat, and gastric acid damage, improving storage and processing stability. It also enables slow intestinal release, addressing the industry pain point of "high in vitro activity but poor in vivo absorption" for plant actives. This helps health supplements and functional foods strengthen their efficacy claims and enhance core competitiveness.

3. **Full-Scenario Adaptability:** Compatible with industrial production, accelerating product launch. Its wide pH range, high process tolerance, and excellent compatibility allow direct integration into existing production lines without major equipment or formulation changes, significantly shortening the product development cycle and time-to-market. Flexible dosage (0.05%–0.5% in food, 0.1%–1.0% in health supplements) suits product development across different price segments, catering to both mass markets and premium sectors.
4. **One-Ingredient, Multi-Functional Integration:** Simplifies formulation systems, achieving significant cost and efficiency benefits. Integrating antioxidant, antimicrobial, flavoring, functional, and nutritional properties, it can replace multiple components such as antioxidants, preservatives, flavorings, and functional raw materials. This reduces the number of ingredients and addition steps in formulations, lowering production and R&D costs while improving formulation stability and reducing post-market quality risks, creating higher profit margins for enterprises.
5. **Natural & Compliant Attributes:** Aligns with industry trends, seizing market opportunities. Made from fully natural plant materials using clean processes and meeting compliance standards, it perfectly aligns with the global "clean label" and "natural health" consumption trends. This can facilitate product entry into premium supermarkets, cross-border e-commerce channels, and help avoid market sentiment risks associated with chemical additives, enhancing brand reputation and consumer loyalty.

Summary

Rosemary Grapefruit Concentrate Powder achieves a deep integration of professionalism and commercial viability by building on "stable physicochemical characteristics as the foundation, synergistic multifunctionality as the core, and unique technological barriers as the support." It meets the technical R&D standards and industrial production needs of the food, health product, and daily chemical industries while helping enterprises optimize product structures, create differentiated selling points, and reduce overall costs through its "natural, multifunctional, and highly adaptable" properties. As a high-value-added raw material aligned with industry upgrade trends, it boasts extensive application scenarios and significant commercial potential, making it a core enabling component for enterprises to position themselves in the health consumption sector and enhance market competitiveness.