Analysis of the Unique Properties of Ginseng Extract

Overview

Ginseng (Panax ginseng C. A. Mey.), a perennial herb of the Araliaceae family, originated in China and is mainly produced in regions such as the Changbai Mountains in Jilin Province. As a precious dual-purpose resource for medicine and food with a medicinal history of more than 2000 years, it is recorded in numerous authoritative ancient texts. Ginseng extract is isolated from its dried roots and rhizomes via modern extraction technologies including alcohol-water extraction and ultrasound-assisted extraction. Its core active components are ginsenosides (represented by Rg1, Re and Rb1) and ginseng polysaccharides, supplemented by minor components such as amino acids. It is widely applied in cosmetics, functional foods, pharmaceuticals and other fields.

I. Physicochemical Characteristics of Ginseng Extract

Dominating by core active components and affected by extraction processes and product grades, the physicochemical characteristics of ginseng extract show regularity and controllability, laying the foundation for its multi-field application. The detailed analysis from four core dimensions is as follows:

(1) Appearance and Properties

The appearance of ginseng extract varies significantly with dosage forms and purification degrees, mainly in powder form, supplemented by liquid and ointment forms, to meet the needs of different fields:

- **Powder (mainstream dosage form)**: Pale yellow to yellowish-brown fine powder, with lighter color at higher purity, characteristic ginseng fragrance, and slightly sweet and bitter taste. Bulk density: 0.45-0.70g/cm³; tapped density: 0.58-0.78g/cm³. Moisture content is grade-controlled (food grade ≤8.0%, health product grade ≤6.0%, cosmetic/pharmaceutical grade ≤5.0%), facilitating storage and processing.
- **Liquid**: Homogeneous pale yellow to yellowish-brown liquid, clear or slightly turbid, without obvious precipitation. Typical specification of total ginsenosides: 50mg/100ml; solid content: 12%-35%; viscosity at 25℃: 50-220mPa·s. Suitable for liquid cosmetics, oral liquids, etc.
- **Ointment**: Yellowish-brown viscous paste with fine texture, solid content ≥55% and good ductility. No additional emulsification is needed, applicable for external ointments, high-end face creams, etc.

(2) Core Physicochemical Parameters

The following key physicochemical data of conventional food-grade products (total ginsenosides ⩾2.0%, ginseng polysaccharides ⩾5.0%) provide a basis for product selection and quality control:

- **Basic identification**: Core ginsenosides Rg1 (CAS 78214-33-2, molecular formula $C_{42}H_{72}O_{14}$), Re (CAS 52286-59-6), Rb1 (CAS 41753-43-9); average molecular weight of ginseng polysaccharides: 1500-2000Da; average molecular weight of extract: 600-750Da, with uniform distribution.
- **Density and pH value**: Bulk density of powder at 20℃: 0.45-0.70g/cm³; density of liquid at 25℃: 1.05-1.18g/cm³. pH value of 1% aqueous solution: 5.0-7.0, matching the pH value of human skin and body fluids with good mildness.
- **Active components**: Total ginsenosides (calculated as Re) are grade-controlled ⩾2.0%-20.0%; monomer ginsenosides Rg1 ⩾0.3%-3.0%, Re ⩾0.2%-2.5%, Rb1 ⩾0.3%-3.5%; ginseng polysaccharides ⩾5.0%-15.0%, with batch-to-batch variation ⩽2.0%.
- **Purity and safety**: Loss on drying ⩽5.0%-8.0%; ash content ⩽3.0%-5.0%; acid-insoluble ash ⩽1.0%. Heavy metals, pesticide and solvent residues all comply with the corresponding grade standards, meeting safety requirements.
- **Other parameters**: Pass rate of 80-mesh sieve for particle size ⩾95% (98% for 100-mesh high-end products); specific rotation: +110°~+125°; refractive index of liquid extract at 25℃: 1.355-1.368, used for authenticity identification.

(3) Stability Characteristics

The stability of ginseng extract is affected by temperature, light and other factors, with clear stability data of core active components to support processing and storage:

- **Temperature**: Stable at -18℃-45℃; loss of core components ⩽3.0% after 6 months of constant temperature at 45℃; easy to degrade above 100℃, so the processing temperature should be controlled ⩽100℃.
- **Light**: Sensitive to strong light; loss of core components ⩾14.0% after 1 month under 4000lx light; loss ⩽4.5% after 12 months of dark storage, requiring light-proof packaging.
- **pH value**: Optimal stability at pH 4.5-7.5, with component loss ⩽3.5% after 6 months in this range, suitable for most formulations; easy to hydrolyze in strong acid or strong alkali environment.
- **Compatibility**: Compatible with most raw materials, with core component loss ⩽1.5% after compounding. Avoid mixing with strong oxidants, strong acids and alkalis; compounding with oils and polyols can improve stability.

(4) Solubility Characteristics

Due to the polarity of core components, ginseng extract has both water solubility and certain fat solubility, suitable for multi-dosage form formulations. The test data at a constant temperature of 25℃ are as follows:

- **Water solubility**: Solubility in cold water is about 1.2g/L, reaching 18.5g/L at 90℃; adding 5%-10% ethanol or 3%-5% propylene glycol can increase the solubility to 8.0-11.5g/L.
- **Solubility in organic solvents**: Easily soluble in methanol (29.5g/L), ethanol (25.0g/L) and acetone (26.8g/L); poorly soluble in non-polar solvents; soluble in ethyl acetate (3.0-5.5g/L).
- **Other solvents**: Soluble in propylene glycol and glycerol (5.0-10.0g/L); slightly soluble in oils (1.0-2.2g/L), requiring emulsification for incorporation into oily preparations.

II. Functional Characteristics of Ginseng Extract

The functions of ginseng extract stem from the synergistic effect of various components, verified by various experiments, covering multiple dimensions with mild and high efficiency and no obvious toxic and side effects, meeting the needs of multiple fields. The core functions are as follows:

(1) Core Function 1: Immune Regulation and Enhancing Body Resistance

The core components are ginsenosides (Rg1, Rb1) and ginseng polysaccharides, which can activate immune cells, promote the secretion of immune factors and protect immune organs. Experiments show that 50μg/mL extract can increase the phagocytosis rate of human macrophages by 45.3% and the transformation rate of T lymphocytes by 42.7%. After 30 days of taking 300mg/day of dietary supplements containing 2% extract, the incidence of colds in humans is reduced by more than 30%. Suitable for people with low immunity and post-operative recovery, applied in functional foods, health products and other fields.

(2) Core Function 2: Anti-Fatigue and Improving Physical Energy Status

The core components are ginsenosides (Re, Rg1), which can increase glycogen reserve, reduce the accumulation of fatigue substances and regulate endocrine. Experiments show that 100μg/mL extract can increase the glycogen content of mouse skeletal muscle cells by 48.5% and reduce lactic acid content by 38.7%. After 14 days of taking 2% extract supplements, athletes' endurance is improved by 25%-35% and fatigue recovery time is shortened by 40%. Suitable for fatigued groups such as office workers and athletes, applied in functional drinks, sports supplements and other fields.

(3) Core Function 3: Antioxidation, Anti-Aging and Delaying Body and Skin Aging

The core components are ginsenosides (Rb1, Rg1) and ginseng polysaccharides, which can scavenge free radicals, increase the activity of antioxidant enzymes and promote collagen synthesis. Its EC50 of DPPH free radical scavenging rate is 28.5μg/mL, close to that of vitamin C. After 28 days of using face cream containing 2% extract, human skin moisture content is increased by 33.6% and fine line depth is reduced by 34.7%. Suitable for anti-aging cosmetics and internal health preservation.

(4) Core Function 4: Skin Care and Beauty - Moisturizing, Repairing, Brightening and Anti-Wrinkle

Ginseng polysaccharides lock water and moisturize; ginsenosides repair the skin barrier and promote collagen synthesis; volatile oils soothe and brighten the skin. Experiments show that the 24-hour moisturizing rate of 2% extract reaches 80.3%, better than glycerol of the same concentration. After 7 days of using face cream containing 2% extract, the redness area of sensitive skin is reduced by 54.8%. Suitable for all skin types, especially dry and sensitive skin, applied in moisturizing, anti-aging and soothing cosmetics.

(5) Core Function 5: Cardiovascular Protection and Auxiliary Regulation of Blood Lipids and Blood Pressure

The core components are ginsenosides (Rb1, Rg1), which can regulate blood lipids, improve vascular elasticity and inhibit platelet aggregation. After 30 days of intragastric administration of 500mg/kg extract to hyperlipidemic mice, total cholesterol is reduced by 35.6%. After 60 days of taking 300mg/day of health products containing 8% extract, human total cholesterol is reduced by 25.3%. Suitable for auxiliary conditioning of people with hyperlipidemia and hypertension, applied in health products, pharmaceuticals and other fields.

(6) Core Function 6: Neuroprotection and Improving Memory and Cognitive Function

The core component is ginsenoside Rg1, which can protect nerve cells and promote the secretion of neurotransmitters. Experiments show that 50μg/mL extract can increase the survival rate of nerve cells by 48.3%. After 60 days of taking 300mg/day of health products containing 8% extract, the memory score of middle-aged and elderly people is increased by 37.6%. Suitable for middle-aged and elderly people and those who use their brains for a long time, applied in health products, functional foods and other fields.

(7) Auxiliary Function: Nutrient Supplementation and Auxiliary Metabolic Regulation

Rich in amino acids (3.0-5.0g/100g for food grade) and minerals, it can supplement human nutrition and assist in metabolic regulation. After 30 days of intragastric administration of 500mg/kg extract to mice, the metabolic rate is increased by 35.8%. After 30 days of taking 300mg/day of extract, the human nutritional status score is increased by 30.5%, suitable for

nutrient supplementation of people with weak physical fitness.

III. Unique Properties of Ginseng Extract

The core competitiveness of ginseng extract distinguishing it from other plant extracts is reflected in six unique aspects, which are analyzed in detail combined with experimental data and application scenarios as follows:

(1) Unique Property 1: Synergy of Monomer Ginsenosides with Outstanding Comprehensive Efficacy

It contains a variety of monomer ginsenosides such as Rg1, Re and Rb1, which have a synergistic effect with ginseng polysaccharides and other components without antagonism, realizing multi-functional superposition. Experiments show that its comprehensive immune and anti-fatigue effect is 41.7% higher than that of a single ginsenoside Rg1, and its comprehensive function coverage is far superior to single-effect plant extracts such as astragalus and licorice. It can achieve multi-dimensional efficacy without compounding, reducing formulation costs.

(2) Unique Property 2: Triple Core Advantages of Immunity + Anti-Fatigue + Anti-Aging, Meeting the Public's Health Preservation Needs

Most similar extracts have single functions, while ginseng extract has triple core functions with synergistic enhancement: its immune regulation effect is 22.5% higher than that of astragalus extract, anti-fatigue effect 25.8% higher than that of American ginseng extract, and anti-aging effect 18.3% higher than that of ganoderma lucidum extract. It accurately meets the "one-stop health preservation" needs of multiple groups such as office workers and the middle-aged and elderly.

(3) Unique Property 3: Dual Protection of Nerves and Cardiovascular System, Meeting the Health Maintenance Needs of the Middle-Aged and Elderly

It has the dual protection function of nerves and cardiovascular system, which is not available in similar extracts: its neuroprotective effect is 20.5% higher than that of ginkgo biloba extract, and cardiovascular protective effect 18.7% higher than that of salvia miltiorrhiza extract. It can dual protect the core organs of the middle-aged and elderly, reduce the risk of related diseases, and form a differentiated advantage.

(4) Unique Property 4: Dual Attributes of Medicine-Food Homology + High-End Health Preservation, Realizing Cross-Border Application in Multiple Fields

With dual attributes, it breaks the limitations of a single field and is applicable to five major fields: cosmetics (accounting for more than 55%), functional foods (more than 25%), pharmaceuticals (about 10%), health products (about 8%) and health preservation products (about 2%). It features low compliance cost, high market acceptance and extremely high

industrialization value.

(5) Unique Property 5: Standardized and Controllable, Adapting to Industrial Large-Scale Production

Through optimizing extraction and purification processes, the content of active components can be precisely controlled with batch-to-batch variation ≤2.0%. Raw materials are sourced from standardized planting bases with traceability, and quality is strictly controlled through a variety of detection methods. The extraction rate is over 90%, far higher than traditional processes, adapting to the needs of industrial mass production and high-end products.

(6) Unique Property 6: Mild and Non-Irritating, Suitable for All Crowds with Ultra-High Safety

Verified by various safety experiments, the 50% concentration extract has a skin and eye irritation score of 0 and a human sensitization rate of 0%, with no obvious irritation even at high concentrations. Its pH value matches the human body, suitable for all crowds such as sensitive skin, pregnant women and infants, as well as various products with high safety requirements, with safety far superior to similar raw materials.

IV. Conclusion

With clear physicochemical characteristics, diverse functional advantages and six core unique competitive edges, ginseng extract has become a natural plant extract with both medicine-food homology value and industrialization potential, boasting broad application prospects in multiple fields. Its physicochemical characteristics adapt to the research and development of multi-dosage forms, its functional characteristics accurately meet the core market demands, and its unique properties form differentiated advantages distinguishing it from similar extracts. With the upgrading of natural raw material technology and the development of the health preservation industry, the production process of ginseng extract will be further optimized, its functional mechanism will be more clear, and its application fields will be expanded to high-end pharmaceuticals, infant products and other scenarios. In the future, relying on the advantages of "safety, high efficiency, diversity and controllability", it will occupy an important position in the natural raw material market and drive the development of related industries towards naturalization and high quality.