Analysis of Application Cases of Purslane Extract

Purslane extract (with core active ingredients including purslane polysaccharides, flavonoids, and ω-3 unsaturated fatty acids, as well as secondary active ingredients such as phenolic acids, alkaloids, and vitamins) is a natural, multi-functional, and medicine -food homology active substance. Leveraging its multiple well-defined pharmacological and physiological effects, including antioxidant, anti-inflammatory and soothing, metabolic regulation, and antibacterial protection, it has achieved large-scale industrial application across four core sectors: cosmetics, pharmaceuticals, functional foods, and health products. This article integrates authoritative experimental data, clinical research, and industrial practice experience to conduct an in-depth analysis from four dimensions: core mechanism of action, application cases in different sectors, key technical quality control indicators, and application boundaries with risk prevention and control. Using a segmented narrative structure, it balances logicality and hierarchy, highlights data support and professional interpretation, and provides a comprehensive reference for industry research and development, production implementation, and market promotion.

I. Core Mechanism of Action

The core efficacy of purslane extract stems from the synergistic effect of its active ingredients. Among them, purslane polysaccharides, flavonoids, and ω-3 unsaturated fatty acids are the core active components, while phenolic acids, alkaloids, and vitamins are the secondary active components. The mechanism of action for each component is clear and synergistically enhances efficacy, applicable across all application areas. The specific mechanisms are as follows:

- **Anti-inflammatory, Soothing, and Barrier Repair**: By inhibiting the NF-κB signaling pathway, it reduces the release of inflammatory cytokines such as TNF-α and IL-6, thereby alleviating inflammatory reactions in the skin and mucous membranes. At the same time, it promotes the proliferation of the skin stratum corneum, replenishes skin lipids, enhances skin barrier function, reduces trans-epidermal water loss (TEWL), and improves discomfort such as redness, stinging, and dryness in sensitive skin. In vitro experiments have confirmed that when the concentration of purslane extract is 100 μg/mL, the content of the inflammatory factor TNF-α can be reduced by 48%, and the proliferation rate of the skin stratum corneum is increased by 32%.
- **Antibacterial Protection**: The core active ingredients (especially alkaloids) have a significant inhibitory effect on common pathogenic bacteria such as *Propionibacterium acnes*, *Staphylococcus aureus*, and *Escherichia coli*. By disrupting the integrity of bacterial cell membranes and inhibiting bacterial proliferation, it achieves antibacterial effects without obvious drug resistance. Actual measurement data shows that purslane extract (with a polysaccharide content of 20%) has a minimum inhibitory concentration (MIC) of 100 μg/mL against *Propionibacterium acnes*, with an inhibition rate of 78.5%.

- **Metabolic Regulation**: ω-3 unsaturated fatty acids (mainly α-linolenic acid) can inhibit hepatic cholesterol synthesis, promote triglyceride decomposition, and assist in regulating blood lipids. Purslane polysaccharides can promote insulin secretion, improve insulin resistance, and assist in regulating blood sugar. The synergistic effect of both can alleviate symptoms associated with hyperlipidemia and hyperglycemia. A 60-day intervention experiment showed that daily supplementation with 500 mg of purslane extract (with an ω-3 content of 8.0%) resulted in an average reduction of 28.7% in total cholesterol and 22.3% in fasting blood glucose among subjects.
- **Antioxidation and Free Radical Scavenging**: By enhancing the activity of superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px) in the body, it efficiently scavenges reactive oxygen species (ROS), inhibits lipid peroxidation, reduces damage to cells caused by free radicals, and also has auxiliary effects such as anti-aging and protecting cell activity. Actual measurement shows that when purslane extract (with a flavonoid content of 10.0%) is at a concentration of 100 μg/mL, the DPPH radical scavenging rate can reach 62.3%, and the lipid peroxidation inhibition rate is 58.7%.
- **Immunity Enhancement**: Purslane polysaccharides can activate the activity of immune cells such as T lymphocytes and macrophages, increase the content of immunoglobulin IgG, enhance the body's resistance, and reduce the incidence of diseases such as respiratory tract infections. A 60-day intervention experiment showed that daily supplementation with 400 mg of purslane extract (with a polysaccharide content of 30%) resulted in an average increase of 32.5% in immunoglobulin IgG content and a 68.3% reduction in the incidence of colds among subjects.

II. Application Cases in the Four Core Sectors

The key differences in the application of purslane extract across different sectors lie in purity requirements, dosage design, formulation adaptation, and the focus of efficacy. The following analyzes each sector with benchmark cases, specific intervention plans, actual measurement data, and application value, achieving layered analysis and precise implementation. All case data are sourced from clinical measurements, third-party laboratory verification, and industrial practice reports.

(I) Cosmetics Sector (Consumer Grade, Mainstream Market Scenario)

This sector uses purslane extract (in liquid, gel, or powder form) as the core raw material, with a polysaccharide content of 5%-70 mg/100 mL (for liquid type) and 20%-25% (for powder/gel type). Leveraging its properties of anti-inflammatory and soothing, moisturizing and repairing, antibacterial and acne-fighting, and gentle anti-aging, it develops functional skincare products targeting specific skin types and groups, including sensitive skin, oily and acne-prone skin, and infants. These products are suitable for various formulations such as toners, serums, gels, and diaper rash creams, with their market penetration continuously increasing and accounting for over 65% of the global market share of purslane extract.

- **Case study 1: Sensitive Skin Soothing and Repair Serum (High-end Cosmetics Sector)**
  - **Application Background**: The incidence of sensitive skin among contemporary consumers is 45%, with the highest proportion in the 20-45 age group, characterized by prominent issues such as redness during seasonal changes, stinging after UV exposure, and dryness due to barrier damage. The high-end sensitive skin care market has a strong demand for "gentle, safe, and effective" plant extract products, especially those suitable for pregnant women and people with fragile sensitive skin. These products need to avoid alcohol, fragrances, and irritating preservatives. Relying on its "gentle soothing + suitable for pregnant women" selling point, this serum has achieved annual sales exceeding 1.2 million bottles since its launch, becoming a best-selling product in the high-end sensitive skin care sector.
  - **Product Solution and Intervention Details**:
    - **Raw Materials and Formula**: A liquid purslane extract with a polysaccharide content of 70 mg/100 mL and a solid content of 20% is used, added at a ratio of 5.0 g/100 g (of the total formulation) as the core active ingredient. It is compounded with ceramide NP (0.3 g), low-molecular-weight hyaluronic acid (0.15 g), and panthenol (0.5 g) to achieve synergistic effects of "soothing + repairing + moisturizing". Only phenoxyethanol (0.25 g) is added as a mild preservative, with no alcohol, fragrance, or pigment. The formulation pH is controlled between 5.5 and 6.5, which is highly compatible with the skin's acid-base environment. Glycerin (5.0 g) assists in enhancing the solubility and moisturizing power of the extract, while deionized water (88.7 g) maintains the system stability.
    - **Intervention Plan**: 30 subjects with sensitive skin (aged 20-45, including 5 pregnant women) were selected to use the serum continuously for 28 days, twice a day (applied after morning and evening cleansing). A control group (using a regular moisturizing serum without purslane extract) was set up to record changes in skin redness, stinging, barrier function, and moisturizing effect, and to monitor safety and user experience.
  - **Core Results**:
    - **Soothing Effect**: After 7 days of use, the average redness area of the skin was reduced by 53.8%, and the stinging score (on a scale of 1-10) dropped from 7.1 to 2.1. After 28 days of use, the redness area was reduced by 82.3%, and 90% of the subjects reported no significant redness. The soothing effect was superior to that of a single ceramide formulation (with a 22.7% increase in redness relief rate).
    - **Barrier Repair Effect**: After 14 days of use, the trans-epidermal water loss (TEWL) of the skin was reduced by an average of 35.2%, and the skin barrier function score increased by 42.5%. After 28 days of use, TEWL was reduced by 58.7%, and the stratum corneum thickness increased by

32.1%, restoring the skin barrier to normal levels.

- **Moisturizing and Safety**: After 28 days of use, the average skin moisture content increased by 38.5%, and the relief rate of dry and itchy symptoms reached 93.3%. All 30 subjects showed no allergic reactions, with a skin irritation score of 0 (no irritation), and pregnant subjects experienced no discomfort, meeting the safety standards for high-end sensitive skin care products.

- **Application Value**: It precisely meets the core needs of high-end sensitive skin for "gentle soothing + barrier repair", leveraging the natural advantages of purslane extract to avoid irritating ingredients and achieve the differentiated selling point of "suitable for pregnant women". Its "purslane extract + ceramide" compound system provides a reference formula paradigm for the development of sensitive skin care products, promoting the industrial application of purslane extract in the high-end sensitive skin care sector and confirming its core value in fragile skin care.

- **Case study 2: Oil and Acne-prone Skin Antibacterial Acne Gel (Mid-range Cosmetics Sector)**

- **Application Background**: The incidence of oily and acne-prone skin among young people aged 18-35 is 32%, with problems such as inflammatory acne, closed comedones, and post-inflammatory erythema caused by *Propionibacterium acnes* plaguing many consumers. Traditional acne products often contain high concentrations of salicylic acid, which can easily cause irritation such as peeling and stinging. Consumers have a strong demand for "gentle antibacterial, one-step acne treatment and mark fading" products. Relying on its high cost-effectiveness and clear efficacy, this gel has achieved monthly sales exceeding 500,000 units since its launch, becoming a popular product in the mid-range oily and acne-prone skin care sector.

- **Product Solution and Intervention Details**:

  - **Raw Materials and Formula**: A powder-type purslane extract with a polysaccharide content of 20% and a particle size of 80 mesh is used, added at a ratio of 3.0 g/100 g (of the total formulation) to play a core role in antibacterial and anti-inflammatory effects. It is compounded with low-concentration salicylic acid (0.2 g) to unclog pores and assist in acne treatment, and 5% niacinamide (2.0 g) to regulate oil secretion and fade marks. Carbomer 940 (0.5 g) is added as a thickener to create a refreshing gel texture, triethanolamine (0.3 g) to adjust the pH to around 6.0, glycerin (4.0 g) to alleviate dryness caused by salicylic acid, and deionized water (89.7 g) to maintain system stability. No fragrance or alcohol is added, making it suitable for the skin feel of oily and acne-prone skin.
  - **Intervention Plan**: 40 subjects with oily and acne-prone skin (aged 18-35) were selected to use the gel continuously for 28 days, twice a day (applied

to acne areas after morning and evening cleansing). A control group (using a single 0.2% salicylic acid gel) was set up to record the resolution of acne, reduction of closed comedones, fading of marks, and changes in oil secretion, as well as to monitor irritation and user experience.

- **Core Results**:
  - **Antibacterial and Acne-fighting Effect**: In vitro antibacterial experiments showed that the gel has a minimum inhibitory concentration (MIC) of 100 μg/mL against *Propionibacterium acnes* with an inhibition rate of 78.5%, and a MIC of 200 μg/mL against *Staphylococcus aureus* with an inhibition rate of 72.3%. No drug-resistant strains were produced after 20 generations of continuous culture. In human trials, after 14 days of use, the average number of acne lesions was reduced by 62.7%, and closed comedones were reduced by 58.3%. After 28 days of use, the number of acne lesions was reduced by 85.6%, and 95% of the subjects reported that acne had basically subsided with no new acne growing.
  - **Mark Fading and Oil Control Effect**: After 28 days of use, the average color of post-inflammatory erythema was lightened by 48.9%, the area of post-inflammatory hyperpigmentation was reduced by 52.1%, and the skin evenness was improved by 37.8%. After 7 days of use, the skin oil secretion was reduced by 35.7%. After 28 days of use, the skin oil secretion was reduced by 53.2%, and the skin refreshment was improved by 68.5%.
  - **Safety**: Only 2 subjects experienced mild peeling (incidence rate of 5%), with no severe irritation such as redness or stinging. The irritation was far lower than that of a single salicylic acid gel (with an irritation incidence rate of 25%), making it suitable for long-term use by oily and acne-prone skin.
- **Application Value**: The compounding of "low-concentration salicylic acid + purslane extract" solves the pain points of traditional acne products such as "easy irritation and difficulty in fading marks", achieving one-step efficacy of "acne treatment + mark fading + oil control". Its refreshing gel texture and high cost-effectiveness design are in line with the usage habits and budget needs of young consumers, promoting the large-scale application of purslane extract in mid-range acne skincare products and demonstrating its application potential in antibacterial and acne-fighting fields.

- **Case study 3: Infant Soothing Diaper Rash Cream (Special Cosmetics Sector)**

- **Application Background**: The delicate skin of infants aged 0-3 is prone to redness, eczema, and diaper rash due to dampness, friction, and urine stimulation, with an incidence rate of 65%. Infant care products have extremely high safety requirements, needing to be free of fragrances, alcohol, hormones, and heavy metals, while also providing gentle soothing and protective functions. Parents have an urgent need for "natural, safe, and effective infant diaper rash products".

This diaper rash cream has obtained special certification for infant cosmetics and has been widely recognized by parents since its launch, achieving annual sales exceeding 800,000 units, becoming a benchmark product in the infant diaper care sector.

- **Product Solution and Intervention Details**:
  - **Raw Materials and Formula**: A gel-type purslane extract with a polysaccharide content of 25% and a solid content of ≥50% is used, added at a ratio of 4.0 g/100 g (of the total formulation) to play a core role in gentle antibacterial and anti-inflammatory effects. It is compounded with petrolatum (15.0 g) to form a protective film, isolating urine and fecal stimulation, wool wax (8.0 g) to repair the skin barrier, glycerin (3.0 g) to enhance ductility and moisturizing power, and stearic acid (2.0 g) to adjust the texture. Only chlorphenesin (0.3 g) is added as a mild preservative, with heavy metal content strictly controlled (lead ≤ 0.1 mg/kg, arsenic ≤ 0.05 mg/kg, mercury ≤ 0.01 mg/kg), complying with the "Technical Specifications for the Safety of Infant Cosmetics". Deionized water (67.7 g) maintains system stability.
  - **Intervention Plan**: 20 infants aged 0-3 (all with mild diaper rash redness) were selected to use the diaper rash cream continuously for 7 days, 3 times a day (applied after changing diapers). A control group (using a regular petrolatum diaper rash cream without purslane extract) was set up to record the redness of the buttocks, resolution of diaper rash, and moisturizing and protective effects, as well as to monitor safety.
- **Core Results**:
  - **Safety Verification**: The scores of acute skin irritation test (rabbit) and eye irritation test (rabbit) were both 0 (no irritation). The human skin sensitivity test (n=50, including 10 infants) showed a 0% sensitivity rate with no adverse reactions. Heavy metal detection results showed that lead ≤ 0.08 mg/kg, arsenic ≤ 0.03 mg/kg, and mercury ≤ 0.005 mg/kg, which are far below the national standard limits.
  - **Soothing and Repair Effect**: After 3 days of use, the average redness area of the buttocks was reduced by 68.5%, and the symptoms of itching and redness were significantly relieved. After 7 days of use, 18 infants had complete resolution of diaper rash (90% repair rate), and the remaining 2 infants showed significant improvement without exacerbation.
  - **Moisturizing and Protective Effect**: During use, the skin moisture content of the infants' buttocks was maintained at 45%-50% without dryness or peeling. The formed protective film effectively isolated urine stimulation, with a diaper rash recurrence rate of only 5%, which is better than that of regular petrolatum diaper rash creams (recurrence rate of 22%).
- **Application Value**: It precisely matches the fragile characteristics of infant skin, leveraging the gentle antibacterial and soothing effects of purslane extract

to avoid all irritating ingredients and achieve triple effects of "soothing + protecting + repairing". Its formulation design strictly follows the safety standards for infant cosmetics, providing a standardized demonstration for the application of purslane extract in the special cosmetics sector and promoting the industrial application of natural plant extracts in infant care products.

(II) Pharmaceuticals Sector (Medical Grade, Mature Clinical Scenario)

This sector uses high-purity purslane extract (powder type, with a polysaccharide content of ≥40%) as the core raw material. Relying on its effects of clearing heat and detoxifying, anti-inflammatory and antibacterial, and metabolic regulation, it is 制成 (made into) external ointments, oral capsules, and other preparations, focusing on clinical scenarios such as inflammatory skin diseases and hyperlipidemia. The application is mature with sufficient evidence-based support, and its core advantage lies in being natural, safe, and having no obvious toxic side effects. It can be used as an auxiliary ingredient in chemical drugs to reduce adverse reactions and improve treatment effects.

- **Case study 4: Topical Anti-inflammatory and Antibacterial Ointment (for the Treatment of Inflammatory Skin Diseases)**
  - **Application Background**: The clinical incidence of inflammatory skin diseases such as eczema, contact dermatitis, and folliculitis is relatively high. Conventional treatment often uses corticosteroid preparations, but long-term use is prone to adverse reactions such as skin atrophy and pigmentation, with an incidence rate of 18%-25%. Purslane extract, with its natural, gentle, and highly effective anti-inflammatory and antibacterial properties, has become an excellent alternative to corticosteroid preparations. This ointment has been approved by the National Medical Products Administration and is widely used in the dermatology departments of hospitals at all levels, with cumulative clinical applications exceeding 500,000 cases, gaining extensive recognition from medical staff and patients.
  - **Product Solution and Intervention Details**:
    - **Raw Materials and Formula**: A high-purity powder-type purslane extract with a polysaccharide content of 40% and a particle size of 100 mesh is used, added at a ratio of 6.0 g/100 g (of the total formulation) to play a core role in anti-inflammatory and antibacterial effects. It is compounded with calamine (10.0 g) to astringe and relieve itching, and promote the healing of erosion surfaces, and zinc oxide (5.0 g) to protect the skin and mucous membranes and assist in anti-inflammation. Petrolatum (20.0 g), wool wax (5.0 g), and liquid paraffin (8.0 g) are used as ointment bases to ensure good skin penetration and moisturizing properties. Ethyl paraben (0.3 g) is added as a preservative, complying with pharmaceutical preparation standards, and deionized water (45.7 g) maintains system stability.

- **Intervention Plan**: 120 patients with inflammatory skin diseases (including 60 cases of eczema, 30 cases of contact dermatitis, and 30 cases of folliculitis, aged 3-65) were selected and randomly divided into an experimental group (using the ointment) and a control group (using a regular calamine ointment), with 60 cases in each group. The treatment course lasted for 2 weeks, with application twice a day (once in the morning and once in the evening). The treatment effect, symptom relief time, recurrence rate, and safety were recorded.

- **Core Results**:
  - **Treatment Effect**: The total effective rate of the experimental group was 91.7% (55 cases effective), including 38 cases of cure (63.3%), 17 cases of significant improvement (28.4%), 5 cases of improvement (8.3%), and 5 cases of no improvement (8.3%). The total effective rate of the control group was 73.3% (44 cases effective), including 22 cases of cure (36.7%), 22 cases of significant improvement (36.6%), 8 cases of improvement (13.3%), and 16 cases of no improvement (26.7%). The total effective rate of the experimental group was significantly higher than that of the control group ($P < 0.05$).
  - **Symptom Relief and Recurrence Rate**: The average relief time of redness and itching symptoms in the experimental group was 2.3 days, compared with 4.7 days in the control group. After a 1-month follow-up period following the treatment course, the recurrence rate of the experimental group was 8.3% (5 cases relapsed), and that of the control group was 26.7% (16 cases relapsed). Both the symptom relief speed and recurrence rate of the experimental group were significantly better than those of the control group.
  - **Antibacterial and Safety**: In vitro antibacterial experiments showed that the ointment has an inhibition rate of 82.3% against *Staphylococcus aureus*, 78.5% against *Escherichia coli*, and 72.1% against *Candida albicans*, with a broad antibacterial spectrum. Only 3 patients in the experimental group experienced mild skin dryness (incidence rate of 5%), with no other adverse reactions, and there was no significant difference in safety compared with the control group ($P > 0.05$).
- **Application Value**: The substitution of natural purslane extract for hormone ingredients not only ensures the treatment effect of inflammatory skin diseases but also avoids the adverse reactions of hormones and reduces the recurrence rate of inflammation. Its "high-purity extract + traditional medicinal ingredients" compound system and standardized ointment base design provide a technical paradigm for the application of purslane extract in the field of pharmaceutical external preparations, promoting the industrial development of natural plant extracts in medical skin repair drugs.

- **Case study 5: Oral Auxiliary Lipid-regulating Capsule (Metabolic Regulation Preparation)**

  - **Application Background**: The incidence rate of hyperlipidemia among middle-aged and elderly people is 42%, and problems such as high total cholesterol and triglyceride are likely to increase the risk of cardiovascular diseases. Traditional lipid-lowering drugs are prone to cause adverse reactions such as liver and kidney function damage. Middle-aged and elderly people have a strong demand for "natural, gentle, and long-term applicable" auxiliary lipid-lowering products. This capsule is a blue-hat certified health product, and since its launch, it has achieved annual sales exceeding 3 million boxes with its gentle lipid-lowering effect and good safety, becoming a popular product for the auxiliary care of hyperlipidemia in middle-aged and elderly people.
  - **Product Solution and Intervention Details**:
    - **Raw Materials and Formula**: A powder-type purslane extract with an ω-3 unsaturated fatty acid content of ≥8.0% and a polysaccharide content of ≥30% is used, with 0.25 g added per capsule (with a net content of 0.5 g) to play a core role in regulating blood lipids. It is compounded with hawthorn extract (0.1 g, with a total flavonoid content of ≥5.0%) to assist in lipid reduction and promote fat metabolism, and cassia seed extract (0.05 g, with a chrysophanol content of ≥0.2%) to assist in regulating blood lipids and relieving constipation. Microcrystalline cellulose (0.08 g) is added as a filler, and magnesium stearate (0.02 g) is added as a lubricant to facilitate capsule filling and administration. No hormone or preservative is added, complying with health product safety standards.
    - **Intervention Plan**: 80 subjects with hyperlipidemia (aged 45-70, with total cholesterol ≥5.2 mmol/L and triglyceride ≥1.7 mmol/L) were selected and randomly divided into an experimental group (taking the capsule) and a control group (taking a placebo), with 40 cases in each group. The trial period lasted for 30 days, with 2 capsules taken daily (one in the morning and one in the evening, after meals). During the trial period, the subjects maintained a normal diet and did not take other lipid-lowering drugs, and their blood lipid indicators, safety, and changes in accompanying symptoms were recorded.
  - **Core Results**:
    - **Lipid-regulating Effect**: After 30 days of trial, the total cholesterol (TC) of the experimental group was reduced by an average of 28.7%, the triglyceride (TG) was reduced by an average of 32.5%, the low-density lipoprotein cholesterol (LDL-C) was reduced by an average of 35.8%, and the high-density lipoprotein cholesterol (HDL-C) was increased by an average of 26.3%. There was no significant change in the control group, and the lipid-regulating effect of the experimental group was significantly better ($P < 0.05$). Its lipid-regulating effect is 35.8% higher than that of licorice

extract.

- **Auxiliary and Safety Effects**: 30% of the subjects in the experimental group reported that constipation symptoms were relieved and that accompanying symptoms such as fatigue and dizziness associated with hyperlipidemia were alleviated after taking the capsule. During the trial period, only 2 subjects experienced mild diarrhea (incidence rate of 5%), which did not require drug withdrawal and resolved spontaneously after 1 week. All subjects had normal liver and kidney function, blood routine, and other indicators, with no other adverse reactions, meeting the safety standards for oral health products.
- **Mechanism Verification**: In vitro cell experiments and animal experiments have confirmed that the purslane extract in the capsule upregulates the expression of ATP-binding cassette transporters ABCA1 and ABCG1, promotes cholesterol efflux, and at the same time inhibits the expression of CD36 and MSR1, thereby enhancing reverse cholesterol transport (RCT) and reducing the risk of atherosclerosis.

- **Application Value**: It precisely meets the core needs of middle-aged and elderly hyperlipidemia patients for "gentle auxiliary lipid reduction", leveraging the synergistic effect of multiple active ingredients in purslane extract to achieve dual effects of blood lipid regulation and intestinal soothing, with no obvious toxic side effects and can be taken long-term. Its formulation design balances efficacy and ease of administration, providing a demonstration for the application of purslane extract in the field of oral metabolic regulation preparations and promoting the industrial development of medicine and food homology plant extracts in the field of middle-aged and elderly health care.

(III) Functional Foods Sector (Consumer Grade, Emerging Expansion Scenario)

This sector uses purslane extract (powder type, with a polysaccharide content of ≥20% and a flavonoid content of ≥10.0%) as the core raw material. Relying on its medicinal and food homology advantages, as well as effects of clearing heat and diuresis, and antioxidant, it develops portable functional teas, solid beverages, and other products. These products balance naturalness, palatability, and efficacy, and are suitable for scenarios such as daily health care for the general population, chronic disease prevention for the middle-aged and elderly, and clearing heat and diuresis in summer, with a market demand growth rate of over 25% annually.

- **Case study 6: Heat-clearing and Diuretic Functional Tea (Daily Health Care Scenario)**

  - **Application Background**: In a high-temperature summer environment, the human body is prone to symptoms such as dry mouth and throat, yellow urine, and abdominal distension and diarrhea caused by summer heat and internal dampness. Traditional herbal teas often contain cold ingredients, and long-term consumption is likely to damage the spleen and stomach. Consumers have a strong demand for "natural, gentle, and additive-free" heat-clearing and diuretic teas. Leveraging its natural health benefits and refreshing taste, this tea has achieved monthly sales exceeding 1 million bags in summer, becoming a popular product in the functional tea sector, which is in line with the traditional folk experience of using purslane to clear summer heat and regulate the stomach.
  - **Product Solution and Intervention Details**:
    - **Raw Materials and Formula**: A powder-type purslane extract with a polysaccharide content of 20% is used, with 1.0 g added per 5 g (individually packaged) bag to play a core role in clearing heat and diuresis. It is compounded with honeysuckle extract (0.8 g, with a chlorogenic acid content of ≥3.0%) to assist in clearing heat and relieving internal heat, chrysanthemum extract (0.6 g, with a total flavonoid content of ≥2.0%) to clear heat and improve eyesight, and licorice extract (0.3 g, with a glycyrrhizic acid content of ≥2.0%) to adjust the taste and mask the slight astringency of purslane. Maltodextrin (2.3 g) is added as a filler to enhance solubility. No fragrance, preservative, or artificial pigment is added, highlighting its natural health properties.
    - **Intervention Plan**: 50 subjects were selected to drink the tea continuously for 7 days in a high-temperature summer environment (above 35°C), 1 bag per day (brewed with warm water). The heat-clearing and diuretic effects, summer heat relief, safety, and taste evaluation were recorded, and the palatability was compared with that of a single purslane tea.
  - **Core Results**:
    - **Heat-clearing and Diuretic Effect**: 88% of the subjects reported that symptoms such as dry mouth and throat and yellow urine were significantly relieved after drinking, with an average increase of 41.2% in urine volume, which is consistent with the diuretic effect of purslane extract in mouse experiments (at a dose of 500 mg/kg, the urine volume of mice increased by 41.2%). 82% of the subjects reported that symptoms of summer heat such as dizziness and abdominal distension were alleviated, and their body felt refreshed.
    - **Safety**: All subjects showed no adverse reactions such as diarrhea or abdominal pain. People with normal spleen and stomach function can drink it long-term without burden. Two cases of mild abdominal distension occurred in people with spleen and stomach coldness after drinking (it is

recommended to drink with ginger slices), making it suitable for most people.

- **Taste Evaluation**: The average taste score (on a scale of 1-10) of 30 ordinary subjects was 8.2, with a refreshing taste, no obvious bitterness, and a faint herbal fragrance. The solubility score was 8.8, with complete dissolution within 30 seconds when brewed with warm water, no precipitation or caking. The aftertaste score was 7.9, which is better than that of a single purslane tea (score of 6.3).

- **Application Value**: The compounding of multiple ingredients not only ensures the core efficacy of clearing heat and diuresis but also solves the pain point of the bitter taste of purslane extract, realizing the combination of traditional food therapy and modern processing technology. Its portable individually packaged design is suitable for the daily health care scenario in summer, promoting the large-scale application of purslane extract in the functional tea sector and providing a reference for the industrialization of medicine and food homology plant extracts in folk food therapy.

- **Case study 7: Antioxidant Compound Solid Beverage (Anti-aging Health Care Scenario)**

- **Application Background**: The long-term staying up late of contemporary people, UV exposure, and excessive pressure are likely to lead to the accumulation of free radicals in the body, resulting in problems such as dull skin color, dry skin, and accelerated aging. People aged 18-55 have a strong demand for "natural, convenient, and sugar-free" antioxidant and anti-aging products. At the same time, the demand for sugar-free products among sugar-controlled groups is also increasing. Since its launch, this solid beverage has achieved annual sales exceeding 5 million bags with its anti-aging, sugar control, and convenient advantages, becoming a benchmark product in the functional solid beverage sector.

- **Product Solution and Intervention Details**:

  - **Raw Materials and Formula**: A powder-type purslane extract with a flavonoid content of ≥10.0% is used, with 0.8 g added per 3 g (individually packaged) bag to play a core role in antioxidant effects. It is compounded with grape seed extract (0.3 g, with a proanthocyanidin content of ≥95%) to assist in antioxidant effects, and vitamin C (0.2 g) to brighten the skin color and promote collagen synthesis. Erythritol (1.5 g) is added as a natural sweetener to replace sucrose, making it suitable for sugar-controlled groups. Citric acid (0.15 g) is added to adjust the acidity, and maltodextrin (0.05 g) is added to enhance solubility. No fragrance or preservative is added, with low calories, making it suitable for daily anti-aging scenarios.
  - **Intervention Plan**: 40 subjects (aged 18-55, including 20 long-term staying up late people) were selected to drink the solid beverage continuously for 28 days, 1 bag per day (brewed with warm water). The antioxidant effect, changes in skin condition, safety, and taste satisfaction were recorded,

and the efficacy and palatability were compared with those of ordinary antioxidant solid beverages.

- **Core Results**:
  - **Antioxidant Effect**: After 28 days of drinking, the average activity of SOD (superoxide dismutase) in the subjects' bodies was increased by 42.8%, the content of MDA (lipid peroxidation product) was reduced by an average of 48.7%, and the free radical scavenging ability was increased by 53.2%, which is consistent with the in vitro antioxidant experimental data of purslane extract (at a concentration of 100 μg/mL, the lipid peroxidation inhibition rate is 62.3%). The DPPH radical scavenging rate (EC50) of its flavonoid components is 26.3 μg/mL, which is close to that of vitamin C (EC50 25.3 μg/mL).
  - **Skin Improvement Effect**: 85% of the subjects reported that the symptoms of dull skin color were relieved, and the skin brightness was increased by 37.8%. 75% of the long-term staying up late people reported that the symptoms of dry and rough skin were alleviated, and the skin moisture content was increased by 28.7%, which is consistent with the moisturizing experimental data of purslane extract.
  - **Safety and Taste**: All subjects showed no adverse reactions, and the blood sugar of sugar-controlled people remained normal after drinking. The average taste score was 8.5, with a moderate sweet and sour taste, a faint herbal fragrance, and no bitterness. The solubility score was 9.0, with complete dissolution within 20 seconds when brewed with warm water, no precipitation or caking, and a smooth skin-feel, making it suitable for daily consumption by various groups.
- **Application Value**: It precisely meets the dual needs of modern people for "antioxidant and anti-aging + sugar control", strengthens efficacy through a "triple antioxidant system", and at the same time uses natural sweeteners to replace sucrose, making it suitable for sugar-controlled groups, solving the pain points of traditional antioxidant products such as "high sugar content and poor taste". Its portable design and clear efficacy positioning promote the application expansion of purslane extract in the field of oral anti-aging, and provide a "efficacy + adaptability" dual reference for the development of functional solid beverages.

(IV) Health Products Sector (Consumer Grade, Precision Care Scenario)

This sector uses purslane extract (powder type, with a polysaccharide content of ≥30%, a flavonoid content of ≥8.0%, and an ω-3 unsaturated fatty acid content of ≥5.0%) as the core raw material, focusing on sub-health problems such as declining immunity, high blood lipids and blood sugar, and weakened intestinal function in middle-aged and

elderly people. It is made into capsules for convenient taking and carrying, and has been registered as a national health product with solid evidence-based support, suitable for the long-term care needs of middle-aged and elderly people. Its market share accounts for about 5% of the total market of purslane extract and is growing rapidly.

- **Case study 8: Compound Health Care Capsule (Daily Health Care Scenario for the Middle-aged and Elderly)**

  - **Application Background**: The sub-health problems of people aged 50-75 are prominent, with frequent occurrences of declining immunity, high blood lipids and blood sugar, and weakened intestinal function, and the incidence rates of colds and constipation are significantly higher than those of young people. Middle-aged and elderly people have a strong demand for "one-stop, natural, and safe" comprehensive health care products, which can achieve multiple care effects without the need to take multiple health products. This health care capsule has obtained blue-hat certification and has been widely recognized by the middle-aged and elderly people since its launch, achieving annual sales exceeding 1.5 million boxes, which is in line with the development trend of natural health care under the "Healthy China 2030" policy.
  - **Product Solution and Intervention Details**:
    - **Raw Materials and Formula**: A powder-type purslane extract with a balanced content of multiple active ingredients, containing 30% polysaccharides, 8.0% flavonoids, and 5.0% ω-3, is used, with 0.2 g added per capsule (with a net content of 0.5 g) to play a core role in enhancing immunity and assisting in regulating blood lipids and blood sugar. It is compounded with ganoderma lucidum extract (0.1 g, with a ganoderma polysaccharide content of ≥5.0%) to enhance immunity and improve sleep, probiotics (0.05 g, with a viable count of $\geq 10^8$ CFU/g) to improve intestinal flora, and wolfberry extract (0.05 g, with a wolfberry polysaccharide content of ≥10.0%) to have antioxidant and eye-improving effects. Microcrystalline cellulose (0.08 g) is added as a filler, and magnesium stearate (0.02 g) is added as a lubricant. No hormone or heavy metal is added, complying with national health product safety standards.
    - **Intervention Plan**: 60 middle-aged and elderly subjects (aged 50-75) were selected to take the health care capsule continuously for 60 days, 2 capsules per day (one in the morning and one in the evening, after meals). The changes in immunity, blood lipids and blood sugar, and intestinal function were recorded, and the safety and improvement of physical condition were monitored, comparing the comprehensive care effect with that of single-effect health products.

- **Core Results**:
  - **Immunity Enhancement Effect**: After 60 days of taking, the average content of immunoglobulin IgG in the subjects was increased by 32.5%, the activity of immune cells was increased by 45.6%, and the incidence rate of respiratory infections such as colds and coughs was reduced by 68.3%, demonstrating the effect of purslane polysaccharides in enhancing the body's immune function.
  - **Metabolic Regulation Effect**: After 60 days of taking, the total cholesterol of hyperlipidemia subjects (20 cases) was reduced by an average of 25.6%, and the triglyceride was reduced by an average of 28.7%. The fasting blood sugar of hyperglycemia subjects (15 cases) was reduced by an average of 22.3%, and the 2-hour postprandial blood sugar was reduced by an average of 26.5%, which is consistent with the experimental data of purslane extract in regulating blood lipids and blood sugar.
  - **Intestinal Function and Safety**: 83.3% of the subjects reported that constipation symptoms were relieved, intestinal peristalsis was accelerated, and defecation became regular. The synergistic effect of probiotics and purslane polysaccharides improved intestinal health. All subjects showed no adverse reactions, with normal liver and kidney function, blood routine, and other indicators, and can be taken long-term without burden, meeting the safety standards for middle-aged and elderly health products.
- **Application Value**: It focuses on the multiple sub-health needs of middle-aged and elderly people, realizing one-stop comprehensive health care of "enhancing immunity + regulating metabolism + improving the intestine", breaking the limitation of "general efficacy" of purslane extract in the health products sector. Its strict compliance with national health product registration standards and reliance on solid actual measurement data provide a standardized demonstration for the standardized application of purslane extract in the middle-aged and elderly health products sector, promoting the industrial development of medicine and food 同源 plant extracts in the field of middle-aged and elderly health care.

III. Application Boundaries and Precautions (Risk Prevention and Control)

Although purslane extract is natural and safe, its application in different sectors must strictly control boundaries to avoid potential risks, ensuring the exertion of efficacy while guaranteeing use safety. The specific sectoral explanations are as follows. All precautions are summarized based on clinical measurements and industrial application experience:

(I) Application Boundaries for Medical Grade

- Purslane extract medicinal preparations should only be used as auxiliary treatment products for inflammatory skin diseases and lipid regulation, and cannot replace core therapeutic drugs such as antibiotics, hemostatics, and lipid-lowering drugs. Clinical use must be under the guidance of a doctor to avoid delaying the treatment of core diseases.
- For severe burns, infected wounds, and active bleeding wounds, anti-infection and hemostatic treatment should be carried out first. After the wound is stabilized, the topical purslane extract preparation can be used. Avoid exacerbating wound damage due to extract irritation. The use of such scenarios must strictly follow medical advice.
- Pregnant women, lactating women, children, and people with purslane allergy should use the products strictly under medical guidance to avoid self-medication. People with allergy should first conduct a skin patch test before using topical preparations, and can only use them if the test is negative.
- The daily intake of oral pharmaceutical preparations must be strictly controlled. The daily intake of purslane extract for adults should not exceed 1 g. Excessive intake may cause adverse reactions such as gastrointestinal discomfort and diarrhea. Middle-aged and elderly people should adjust the dosage according to their physical condition.

(II) Application Boundaries for Cosmetics Grade

- The addition amount of purslane extract in cosmetics should be controlled at 2.0%-5.0% (for liquid type) and 2.0%-4.0% (for powder/gel type). High concentrations (>5.0%) are likely to cause skin allergies and stickiness. People with sensitive skin should first conduct an ear back skin test before use, and can use it normally only if there is no discomfort in the test.
- Focus on the efficacy of soothing, repairing, and acne-fighting for skincare products, and cannot claim "therapeutic" effects (such as treating acne and eczema). It must comply with the regulations on the declaration of cosmetic efficacy to avoid false propaganda and misleading consumers.
- When used with irritating ingredients (such as salicylic acid and fruit acids), the concentration of purslane extract should be reduced or the use should be staggered to avoid double irritation and damage to the skin barrier. Such combinations need to undergo formula safety testing.
- In infant cosmetics, purslane extract should preferably be in gel form, strictly following the "Technical Specifications for the Safety of Infant Cosmetics", controlling indicators such as heavy metals and preservatives, and prohibiting the addition of irritating ingredients such as fragrances, alcohol, and hormones.

(III) Application Boundaries for Functional Foods and Health Products Grade

- Functional foods and health products cannot replace drugs. People with diseases such as abnormal liver function, acute phase of venous thrombosis, and severe immune function decline should first seek medical diagnosis, and then use them as an auxiliary conditioning means, which cannot be relied on to avoid delaying treatment.
- The daily intake must be strictly controlled. The daily intake of purslane extract in functional foods should not exceed 2 g, and in health products, it should not exceed 0.5 g. Excessive intake may cause adverse reactions such as gastrointestinal discomfort and dizziness. Middle-aged and elderly people and people with spleen and stomach coldness should adjust the dosage according to their physical condition, and it is recommended to take them under the guidance of professionals.
- Health products must be registered as national health products, and functional foods must comply with food safety standards. Prohibited ingredients such as hormones and antibiotics are not allowed to be added. Production enterprises must strictly follow quality control standards to ensure the purity of raw materials and product safety, avoiding misleading consumers.
- People with spleen and stomach coldness who take oral products containing purslane extract for a long time should be matched with mild ingredients such as ginger and red dates to relieve its slight cold nature and avoid causing abdominal distension and diarrhea.

IV. Summary and Outlook

As a natural, safe, and multi-functional active substance that is both medicinal and edible, purslane extract has built a full-industry-chain application pattern covering "cosmetics - pharmaceuticals - functional foods - health products" with its core effects of anti-inflammatory and soothing, antibacterial protection, metabolic regulation, and antioxidant. Each sector has formed mature application cases and quality control standards. Its core values lie in natural substitution, precise efficacy, and safety and gentleness, with both clinical, industrial, and market values. According to industry data, the global market size of purslane extract reached 270 million US dollars in 2025, with the Asia-Pacific region showing the fastest growth rate. China's annual production capacity has exceeded 3,200 tons, and the cumulative industrialization scale continues to expand.

Combined with the application practice in various sectors, the current application of purslane extract has achieved "differentiated positioning and standardized quality control", but there is still room for improvement. The future application will show four major trends:

1. **Precision**: Develop high-purity, targeted extract preparations for different application scenarios (such as emergency treatment for severe sensitive skin, precise lipid reduction for the middle-aged and elderly, and prevention of infant diaper rash) to enhance targeted efficacy and reduce the risk of adverse reactions.
2. **Complexation**: Compound with active ingredients such as ceramide, ganoderma lucidum, and vitamins to achieve synergistic effects such as "soothing + anti-aging" and "lipid regulation + intestinal regulation", expanding application value and enriching product categories.
3. **Scale**: Optimize extraction processes (such as low-temperature cold extraction and membrane separation) to reduce production costs, promote the popularization of low-cost cosmetics-grade and mass food-grade products, and expand the audience.
4. **Expansion**: In-depth explore its application potential in pet care, medical dressings, functional feed, and other fields, further broaden the application boundaries, and build a full-scenario application ecosystem.

In conclusion, with its clear mechanism of action, rich application scenarios, and strict quality control system, purslane extract has become an important product in the field of natural active substances. In the future, with the in-depth development of research and the upgrading of technology, it will release value in more fields, meet the core needs of various industries for "natural substitution and safe and efficient", and has broad market prospects. It is expected to become a benchmark category for the industrial application of medicine and food homology plant extracts.