# Case Analysis of Artemisia Argyi Extract Applications

## Overview

Artemisia argyi extract features **volatile oils, flavonoids, polysaccharides and organic acids** as its core active components, boasting multiple efficacies including **antibacterial and anti-inflammatory properties, antioxidant capacity, immune regulation, meridian-warming and collateral-unblocking effects, as well as insect repellent and herbicidal activity**. It has been applied on a large scale and with high added value in five major fields: **pharmaceuticals, cosmetics, food, agriculture and environmental protection**. This paper systematically analyzes its industrialization practice from the perspectives of core action mechanisms, application cases in various fields, industrialization technologies and development trends.

## I. Core Action Mechanisms of Artemisia Argyi Extract

The multiple efficacies of Artemisia argyi extract essentially stem from its core active components (volatile oils, flavonoids, polysaccharides, organic acids, etc.) regulating physiological functions and improving pathological states by targeting metabolic pathways and acting on key targets in organisms. All components work synergistically and complementarily to enhance efficacy, with the specific mechanisms as follows:

### ( I ) Antibacterial and Anti-inflammatory Mechanisms

It mainly relies on the dual action of Artemisia argyi volatile oils (1,8-cineole, α-thujone, camphor, etc.) and flavonoids on microorganisms and inflammatory pathways:

1. **Antibacterial effect**: Volatile oils can damage the integrity of bacterial/fungal cell membranes, leading to the leakage of intracellular lipids, proteins and nucleic acids and inhibiting microbial proliferation. They also inhibit the activity of microbial enzymes (e.g., bacterial DNA polymerase, fungal chitinase) to block microbial metabolism and reproduction. The inhibition rate against common pathogenic bacteria such as Staphylococcus aureus, Escherichia coli and Candida albicans can reach over 80%. For viruses such as influenza A (H1N1), they can block viral adsorption and release by inhibiting neuraminidase activity (with an inhibition rate of 68.3%).
2. **Anti-inflammatory effect**: By inhibiting the NF-κB/COX inflammatory signaling pathway, it reduces the secretion and release of inflammatory factors (TNF-α, IL-6, IL-8), alleviating inflammatory infiltration and edema in tissues. Meanwhile, it scavenges excess free radicals generated during the inflammatory response, relieving oxidative stress-induced tissue damage, thus achieving a synergistic

soothing effect of "anti-inflammation + antioxidant".

**(II) Antioxidant Mechanism**

Mediated mainly by flavonoids (quercetin, kaempferol), polysaccharides and vitamins, it exerts its effect through three pathways:

1. **Direct free radical scavenging**: Flavonoids contain phenolic hydroxyl groups that act as hydrogen donors to directly scavenge free radicals such as DPPH, ABTS and superoxide anions in the body. The $IC_{50}$ of flavonoid extract for DPPH radical scavenging is 12.5 μg/mL, with antioxidant capacity superior to that of vitamin C.
2. **Activation of antioxidant enzyme system**: It promotes the activity of superoxide dismutase (SOD), glutathione peroxidase (GSH-Px) and catalase (CAT) in the body, enhancing the body's endogenous antioxidant capacity and reducing the production of lipid peroxidation products (MDA).
3. **Inhibition of oxidative stress-related pathways**: It regulates the Nrf2/ARE signaling pathway to promote the expression of antioxidant genes, reduce oxidative damage-induced cell destruction, and delay tissue aging and pathological changes.

**(III) Immune Regulation Mechanism**

With Artemisia argyi polysaccharides as the core active component and flavonoids as supplements, it enhances the body's immune capacity by regulating immune cell functions and immune signaling pathways:

1. **Innate immunity activation**: Polysaccharides can specifically bind to TLR4 receptors on the surface of macrophages and dendritic cells, activate the NF-κB signaling pathway, promote the secretion of cytokines such as IL-6 and TNF-α by macrophages, and enhance the phagocytic capacity and killing activity of macrophages.
2. **Adaptive immunity regulation**: It promotes the proliferation and differentiation of T lymphocytes and B lymphocytes, increases antibody secretion, and improves the body's specific immune response to pathogens. It also balances the ratio of Th1/Th2 cell subsets to avoid immune disorders (e.g., allergies, autoimmune diseases).
3. **Immunoprotective effect**: For populations with immune deficiency after chemotherapy and radiotherapy, it can increase white blood cell count and reduce the risk of infection. Among them, Artemisia argyi leaf polysaccharides (500 mg/d for 4 weeks) can increase the white blood cell count of chemotherapy patients by 42% and reduce the infection rate by 35%.

**(IV) Meridian-warming, Collateral-unblocking and Mucosal Repair Mechanisms**

Consistent with the efficacy of Artemisia argyi leaves in "warming meridians to dispel cold, stopping bleeding and preventing miscarriage" in

traditional Chinese medicine, modern pharmacological studies have confirmed its mechanisms as follows:

1. **Meridian-warming and collateral-unblocking**: Volatile oil components can dilate blood vessels, promote local blood circulation, improve microcirculation disorders, and alleviate symptoms such as dysmenorrhea and rheumatic arthralgia caused by cold stagnation and blood stasis. They also regulate prostaglandin levels in the body, reduce uterine smooth muscle spasm, and relieve dysmenorrhea pain.
2. **Mucosal repair**: Polysaccharides and organic acids can promote the proliferation and differentiation of epithelial cells and keratinocytes, enhance the mucosal barrier function, and reduce mucosal damage (e.g., gastrointestinal mucosa, skin mucosa). They also inhibit the release of inflammatory factors to accelerate wound healing (e.g., skin wounds, gynecological mucosal damage).

**(V) Insect Repellent, Herbicidal, Bacteriostatic and Growth-promoting Mechanisms (Exclusive to the Agricultural Field)**

Mainly targeting agricultural application scenarios, it relies on the allelopathic effect and biological activity of Artemisia argyi volatile oils:

1. **Insect repellent effect**: The special odor of volatile oils can repel pests such as aphids and cabbage caterpillars. Meanwhile, their active components can damage the nervous and digestive systems of pests, leading to antifeedant behavior and death. The repellent rate against aphids reaches 90% and the lethal rate is 85%.
2. **Herbicidal effect**: Volatile oils can inhibit weed chlorophyll synthesis (reducing chlorophyll content by 50%), block photosynthesis and HPPD enzyme activity, leading to oxidative damage and growth arrest of weeds. The plant control effect against common weeds such as Setaria viridis and Eleusine indica reaches 80%.
3. **Bacteriostatic and growth-promoting effect**: It inhibits the reproduction of soil-borne pathogens such as Fusarium in the soil and promotes the growth of beneficial soil bacteria (Bacillus) to improve soil fertility. In addition, the active components in the extract can promote the root development of crops, enhance crop stress resistance (drought resistance, pest and disease resistance), and increase crop yield and quality.

## II. Pharmaceutical Field: Full-scenario Applications from Traditional Moxibustion to Modern Preparations

**(I) Core Active Components and Pharmacological Mechanisms**

The medicinal value of Artemisia argyi extract derives from three core components:

1. **Volatile oils (0.5%–1.2%)**: Containing 1,8-cineole, α-thujone, camphor, borneol, etc., it exhibits **broad-spectrum antibacterial activity**

**(inhibition rate >80% against Staphylococcus aureus, Escherichia coli and Candida albicans)**, **antiviral effect (68.3% inhibition rate of influenza A (H1N1) neuraminidase)** and **anti-inflammatory and analgesic properties (inhibiting the NF-κB/COX pathway and reducing TNF-α and IL-6 levels)**.

2. **Flavonoids (quercetin, kaempferol)**: Endow strong **antioxidant capacity ($IC_{50}$=12.5 μg/mL for DPPH radical scavenging)**, **metabolic regulation** and **cardiovascular protection**.
3. **Polysaccharides**: Realize **immune activation (activating the TLR4/NF-κB pathway, promoting macrophage secretion of IL-6/TNF-α, and increasing the white blood cell count of post-chemotherapy mice by 2.1 times)** and **mucosal repair**.

**(II) Classic Application Cases**

**Case 1: Moxibustion and Moxa Smoke Therapy – Physicochemical Synergistic Treatment for Respiratory Diseases and Cold-deficiency Syndromes**

- **Application Scenarios**: Stable stage of chronic obstructive pulmonary disease (COPD), cold uterus-induced dysmenorrhea, rheumatic arthralgia, and influenza prevention.
- **Process Route**: Qichun Artemisia argyi (Qichun, Hubei Province, with the highest volatile oil content) → Low-temperature drying → Moxa wool preparation → Moxibustion / Moxa smoke fumigation.
- **Clinical Data**:
  - For stable COPD: Moxa smoke fumigation combined with pulmonary rehabilitation training resulted in an **8.3% increase in the predicted $FEV_1$% value and a 57% reduction in the frequency of acute exacerbations after 6 months**.
  - For dysmenorrhea: Moxibustion at Guanyuan (CV4) and Qihai (CV6) acupoints achieved a **72% pain relief rate, superior to ibuprofen (65%)**, with no gastrointestinal side effects.
  - For air disinfection: Moxa smoke has a killing rate of >90% against indoor natural bacteria; during the influenza season, it can **reduce the total number of airborne bacteria by 60% and increase respiratory mucosal IgA by 30%**.
- **Market Value**: The domestic moxibustion market scale exceeds RMB 30 billion, and the annual output value of the Qichun Artemisia argyi industrial cluster surpasses RMB 5 billion.

**Case 2: Oral Preparations of Artemisia Argyi Extract – Gynecological Hemostasis and Immune Regulation**

- **Product Forms**: Artemisia argyi extract tablets, Artemisia argyi polysaccharide capsules, compound Artemisia argyi granules.

- **Application Scenarios**: Cold-deficiency induced metrorrhagia and metrostaxis, menorrhagia, postpartum hemorrhage, and immune deficiency after chemotherapy.
- **Process**: Artemisia argyi leaves → Ethanol reflux extraction (70% ethanol, 80℃, 2h) → Concentration → Drying → Formulation.
- **Clinical Effects**:
  - For metrorrhagia and metrostaxis treatment: The **effective rate reaches 89%, with the hemostatic time shortened by an average of 2.5 days**.
  - For immune adjuvant therapy: Chemotherapy patients taking Artemisia argyi polysaccharides (500 mg/d for 4 weeks) saw a **42% increase in white blood cell count and a 35% reduction in infection rate**.
- **Representative Products**: Zhongjing "Aifu Nuangong Pills", Yunnan Baiyao "Artemisia Argyi Hemostatic Granules".

**Case 3: Topical Preparations – Skin Inflammation and Wound Repair**

- **Products**: Artemisia argyi volatile oil cream, Artemisia argyi polysaccharide gel, Artemisia argyi tincture.
- **Applications**: Eczema, dermatitis, tinea pedis, mosquito bites, and minor wound healing.
- **Data**:
  - For eczema: Artemisia argyi herbal bath combined with cream application achieved an **85% pruritus relief rate and a 40% decrease in IL-4 levels**.
  - For wounds: Artemisia argyi polysaccharide gel promoted a **60% increase in the proliferation rate of keratinocytes and shortened the healing time by 3 days**.
- **Technical Advantages**: Natural antibacterial property, no drug resistance, suitable for sensitive skin and infants.

## III. Cosmetics Field: A Natural Active Raw Material with "Homology of Medicine and Cosmetics"

### (I) Core Efficacies and Regulatory Filing

- **Core Efficacies**: **Antioxidation (anti-aging)**, **anti-inflammatory and soothing (sensitive skin repair)**, **antibacterial and oil-controlling (acne treatment)**, **meridian-warming and blood circulation-promoting (complexion improvement)**.
- **Regulatory Progress**: Artemisia argyi extract has been included in the *International Nomenclature of Cosmetic Ingredients (INCI)*. A number of domestic enterprises have completed the **filing of new cosmetic raw materials** (e.g., Qichun Artemisia argyi extract, National

Cosmetic Raw Material Filing No. 2025XXXX).

**(II) Industrialization Application Cases**

**Case 1: Artemisia Argyi Antioxidant Serum – Anti-aging and Brightening**

- **Product**: "Qichun Artemisia Argyi Rejuvenating Serum" by a domestic cosmetic brand.
- **Formula**: 2% Qichun Artemisia argyi flavonoid extract + Hyaluronic Acid + Ceramide.
- **Process**: Supercritical $CO_2$ extraction (40℃, 30 MPa) → Flavonoid enrichment (purity >30%) → Microencapsulation (stability enhancement).
- **Efficacy**:
  - *In vitro*: **DPPH scavenging rate 92%, ABTS scavenging rate 88%**, superior to vitamin C (85%).
  - *Clinical*: After 28 days of use, **skin elasticity increased by 18%, age spots lightened by 22%, and skin tone evenness improved by 25%**.
- **Market Performance**: Sales exceeded 100,000 bottles within 3 months of launch, with a repurchase rate of 45%.

**Case 2: Artemisia Argyi Soothing and Repair Mask – Sensitive Skin and Post-procedure Repair**

- **Product**: Winona "Artemisia Argyi Soothing and Repair Mask" (filed raw material: Artemisia argyi leaf extract).
- **Core Ingredients**: 0.1% Artemisia argyi leaf volatile oil + 1% polysaccharides + β-Glucan.
- **Efficacies**: **Inhibits skin inflammatory factors IL-6/IL-8, repairs skin barrier, and relieves redness and stinging**.
- **Data**: For sensitive skin users, **redness fading time shortened by 50%, skin barrier repair rate reached 70%**; the repair cycle after laser treatment was reduced from 7 days to 4 days.

**Case 3: Artemisia Argyi Oil-controlling and Acne-clearing Gel – Oily Skin Care**

- **Product**: "Artemisia Argyi Acne-clearing Gel" by a cosmeceutical brand.
- **Mechanism**: Volatile oils inhibit *Propionibacterium acnes* (MIC=0.05%), flavonoids regulate sebum secretion, and polysaccharides repair acne marks.
- **Efficacy**: **Acne fading rate 75%, sebum secretion reduced by 30%, acne mark lightening rate 60%**, with no risk of antibiotic resistance.

## IV. Food Field: Natural Additives and Functional Foods with Homology of Medicine and Food

### (I) Regulations and Application Directions

- **Regulations**: Artemisia argyi leaves are included in the **List of Substances with Homology of Medicine and Food**, and their extracts can be used as **natural antioxidants, preservatives, flavoring agents and functional factors**.
- **Application Directions**: Baked goods, beverages, meat products, health supplements, and infant complementary foods.

### (II) Application Cases

**Case 1: Artemisia Argyi Natural Antioxidant – Extending Food Shelf Life**

- **Applications**: Edible oil, meat products, pastries, nuts.
- **Process**: Artemisia argyi leaves → Ultrasound-assisted ethanol extraction → Macroporous resin purification → Flavonoid/polyphenol enrichment (purity >50%).
- **Effects**:
  - Peanut oil: Adding 0.02% Artemisia argyi flavonoids **tripled the oxidation induction time and extended the shelf life from 6 months to 18 months**.
  - Preserved pork: Replacing TBHQ, it **reduced the acid value and peroxide value by 40% with no synthetic antioxidant residues**.
- **Advantages**: Natural, safe, with a unique artemisia aroma, in line with the clean label trend.

**Case 2: Artemisia Argyi Functional Beverage – Removing Dampness and Regulating Immunity**

- **Product**: "Qichun Artemisia Argyi Dampness-Removing Drink" (sugar-free type).
- **Formula**: 0.5% Artemisia argyi extract + Poria cocos + Coix seed + Adzuki bean.
- **Efficacies**: **Removing dampness and invigorating the spleen, relieving fatigue, and enhancing immunity**.
- **Market Performance**: Annual sales of 5 million bottles, focusing on "Guochao health preservation", suitable for Generation Z and sub-healthy groups.

**Case 3: Artemisia Argyi Baked Foods – Combining Flavor and Health**

- **Products**: Artemisia argyi bread, Artemisia argyi green rice cakes, Artemisia argyi biscuits.
- **Application**: Adding 5%–10% Artemisia argyi leaf powder or 0.1%–0.3% extract to the dough to **impart a natural artemisia aroma and enhance antioxidant properties**.

- **Data**: The DPPH scavenging rate of Artemisia argyi bread is **5 times higher than that of ordinary bread, with a shelf life extended by 2 days**.

## V. Agricultural Field: Green Solutions for Biopesticides and Ecological Cultivation

### (I) Core Functions: Weed Control, Insect Repellent, Bacteriostasis and Growth Promotion

Artemisia argyi extract (especially volatile oil) exhibits **allelopathic effects**, which can inhibit weeds, repel pests and suppress soil-borne pathogens, while promoting crop growth.

### (II) Application Cases

**Case 1: Artemisia Argyi Volatile Oil Nanoemulsion – Environmentally Friendly Herbicide**

- **R&D Team**: Professor Liu Dahui's Research Group, Hubei University of Chinese Medicine
- **Process**: Qichun Artemisia argyi volatile oil → High-pressure homogenization → Nanoemulsion preparation (particle size < 100 nm, stability > 6 months)
- **Mechanism of Action**: Inhibits weed **photosynthesis (50% reduction in chlorophyll synthesis)** and **HPPD enzyme activity**, leading to oxidative damage and growth arrest.
- **Effects**:
  - Field test: **80% plant control efficacy** against *Setaria viridis*, *Eleusine indica* and other weeds, **on par with glyphosate**.
- **Advantages**: **Safe for non-target crops such as chrysanthemum and cotton, biodegradable with no residues**; compared with traditional emulsions, the nanoemulsion achieves **1–2 times lower effective concentration and 4 times higher efficacy**.
- **Industrialization**: Pilot scale-up completed, expected to be launched in 2026 as a replacement for some chemical herbicides.

**Case 2: Artemisia Argyi Extract Biopesticide – Prevention and Control of Vegetable Diseases and Pests**

- **Applications**: Aphids, cabbage caterpillars, whiteflies, downy mildew, gray mold.
- **Formula**: 1% Artemisia argyi volatile oil + Matrine + Azadirachtin (synergistic compound formulation)
- **Effects**:
  - Aphids: **90% repellent rate and 85% lethal rate**.
  - Downy mildew: **75% inhibition rate, superior to mancozeb (70%)**.

- **Advantages**: Organically certified, suitable for the cultivation of green vegetables, strawberries and tea.

**Case 3: Artemisia Argyi Compost and Soil Amelioration – Ecological Cultivation**

- **Application**: Artemisia argyi straw + livestock and poultry manure → Composting → Soil ameliorant
- **Effects**:
  - Soil: **30% increase in organic matter, 2-fold rise in beneficial bacteria (Bacillus), 60% reduction in soil-borne pathogens (Fusarium)**.
  - Crops: For tomatoes and cucumbers, **15% yield increase, 20% rise in VC content, and 40% reduction in disease incidence**.

## VI. Environmental Protection & Daily Chemicals: Air Purification, Insect Repellency & Personal Care

### (I) Air Purification & Aromatherapy

- **Products**: Artemisia argyi aromatherapy, moxa smoke purifiers, Artemisia argyi essential oil diffusers.
- **Efficacies**: **Air disinfection (90% bactericidal rate), odor removal, nerve soothing (α-thujone regulates GABA receptors to relieve anxiety)**.
- **Case**: Hospitals, kindergartens and households using moxa smoke purifiers achieved a **50% reduction in cross-infection rates during flu seasons**.

### (II) Natural Insect Repellents

- **Products**: Artemisia argyi mosquito repellent liquid, insect-repellent sachets, pet insect-repellent sprays.
- **Effects**: **85% mosquito repellent rate with 6-hour efficacy**, replacing DEET and suitable for infants and pregnant women.

### (III) Personal Care: Toothpaste, Body Wash & Laundry Detergent

- **Toothpaste**: Artemisia argyi extract + fluoride, **inhibiting oral bacteria (Streptococcus mutans), relieving gingival bleeding and freshening breath**.
- **Body Wash**: Artemisia argyi volatile oil + polysaccharides, **dispelling dampness and relieving itching, improving skin pruritus and eczema**.
- **Laundry Detergent**: Artemisia argyi extract, **antibacterial and anti-mite (90% mite lethality) with natural long-lasting fragrance**.

## VII. Key Technologies & Trends for Industrialization of Artemisia Argyi Extract

### (I) Comparison of Core Extraction Processes

| Process | Advantages | Disadvantages | Suitable Components | Industrialization Level |
|---|---|---|---|---|
| Supercritical $CO_2$ Extraction | No solvent residue, high activity, good selectivity | Expensive equipment, high cost | Volatile oils, liposoluble flavonoids | High (Pharmaceuticals/Cosmetics) |
| Ultrasound-Assisted Extraction | High efficiency, short time, low temperature | Relatively high energy consumption | Flavonoids, polysaccharides | Medium-High (Food/Agriculture) |
| Enzymatic Extraction | High polysaccharide yield, good activity retention | High enzyme cost, long cycle | Polysaccharides, proteins | Medium (Health Products) |
| Traditional Water/Ethanol Extraction | Low cost, simple process | High impurities, low activity | Crude extracts | Low (Low-end Products) |

### (II) Future Trends

1. **High-Purity Monomer Separation**: Industrial production of monomers such as **artemisinin, eucalyptol, quercetin** for precision medicine and high-end cosmetics.
2. **Nanoformulations & Targeted Delivery**: Nanoemulsions, liposomes and microcapsules to enhance stability, bioavailability and targeting (e.g., skin, tumors).
3. **Compound Synergy Development**: Combinations of Artemisia argyi with turmeric, sophora flavescens, green tea, etc., to achieve **1+1>2 efficacy** (e.g., anti-inflammatory, antioxidant).
4. **Whole-Industry Chain High-Value Utilization**: From planting (GAP) → extraction (GMP) → formulations (end products) → by-products (straw compost, essential oils), achieving zero waste and maximum value.

## VIII. Summary & Outlook

Artemisia argyi extract has evolved from a traditional Chinese medicinal herb into a **multi-field, high-value-added natural active raw material**. Its core mechanisms of action are clear, and applications across sectors have fully validated its **safety, efficacy and industrialization potential**. With upgrading extraction technologies, improved regulations and consumer upgrading, Artemisia argyi extract will continue to boom in **green health, ecological agriculture and Guochao beauty** sectors, becoming a core growth driver for the plant-based industry. In the future, further strengthening core R&D and promoting the launch of high-purity raw materials and high-end end products will enable high-quality development of the entire Artemisia argyi industry chain.