

Mechanisms and Research Progress of Traditional Chinese Medicine in the Treatment of Allergic Rhinitis from the Perspective of Modern Medicine

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Received: 10 February 2026/ Accepted: 11 March 2026/ Published online: 15 March 2026

Abstract

This article conducts a systematic review of the biological mechanisms and research progress in traditional Chinese medicine (TCM) for treating allergic rhinitis (AR) from a modern medical perspective. Research indicates that TCM exerts systemic therapeutic effects through a multi-target, multi-level network, with core mechanisms focusing on five key areas: first, the regulation of intestinal microecology, reshaping gut microbiota composition and metabolites based on the “gut-nose axis” theory; second, the repair of the mucosal barrier, protecting nasal epithelial cells by modulating programmed cell death pathways such as pyroptosis, autophagy, and ferroptosis; third, the restoration of immune homeostasis, correcting Th1/Th2 and Th17/Treg imbalances and inhibiting IgE-mediated cascade reactions; fourth, the modulation of inflammatory signaling pathways, including TLRs, NF- κ B, and MAPK; and fifth, neuro-immune regulation, suppressing neuropeptide release and neurogenic inflammation. Current evidence suggests that TCM offers the advantage of “constitutional regulation and prognosis improvement.” Its integration with conventional therapies can significantly lower AR recurrence rates and mitigate drug-related side effects. To address challenges like lack of standardization and mechanistic opacity in TCM research, this review proposes establishing an evidence-based, standardized diagnostic and therapeutic framework. Utilizing whole-genomics, network pharmacology, and artificial intelligence for precise subtyping and personalized treatment is recommended to advance the modernization and scientific development of TCM in AR management.

Keywords: Allergic Rhinitis; Integrated Traditional Chinese and Western Medicine; Mechanism of Action

1. Introduction

1.1. Definition, Epidemiology, and Clinical Burden of Allergic Rhinitis in Modern Medicine

Allergic rhinitis (AR), often known as hay fever, is a chronic inflammatory condition affecting the nasal mucosa that is mainly mediated by immunoglobulin E (IgE) after individuals who are susceptible come into contact with allergens. It is clinically characterized by recurrent episodes of sneezing, rhinorrhea (runny nose), and nasal congestion. In traditional Chinese medicine (TCM), AR falls under the category of the syndromes of Bi Qiu, Qiu Ti, and Qiu Bi.

The global prevalence of AR has increased markedly in recent decades, currently affecting approximately 1.4 billion individuals and establishing it as one of the most common chronic respiratory diseases worldwide. In the United States alone, an estimated 50 million people are affected by AR (Bernstein et al., 2024). The disease imposes a substantial and multifactorial burden. Foremost, it significantly impairs health-related quality of life (HRQoL), leading to sleep disturbances, reduced productivity and absenteeism from work or school, and limited outdoor activity participation in children. Secondly, AR is a major risk factor for several respiratory comorbidities; for example, patients with AR have a several-fold higher risk of developing asthma compared to the general population. Furthermore, AR entails considerable economic costs. Annual work productivity losses attributable to AR in the European Union are estimated at €30–50 billion (Greiner et al., 2011), while direct annual healthcare costs for AR treatment in the United States range from \$2 to \$5 billion .

As a result, AR has become a major global public health concern characterized by substantial clinical and socioeconomic consequences. Current mainstream management in modern medicine, tailored to disease severity, includes allergen avoidance, pharmacotherapy, immunotherapy, and surgery. Although these interventions provide satisfactory symptomatic control for most patients, AR frequently recurs and is often associated with considerable adverse effects. Recent systematic reviews have indicated that TCM interventions can enhance clinical efficacy, reduce total symptom and sign scores, and exhibit a favorable safety profile with fewer adverse events, underscoring their clinical value . However, due to the theoretical complexity and diverse therapeutic modalities of TCM, while numerous independent studies have explored its mechanisms of action in AR, a recent systematic synthesis of the cumulative evidence is still lacking. Therefore, this study reviews and integrates current studies on the mechanistic underpinnings of TCM in the treatment of AR, with the purpose of offering a distinct and relatively thorough summary of the clarified therapeutic mechanisms.

1.2. Significance of Investigating the Mechanisms of TCM in Treating AR from a Modern Medical Perspective

The methodology of Traditional Chinese Medicine (TCM) differs fundamentally from that of modern medicine. In contrast to the structuralist paradigm of modern pathology, which seeks specific anatomical lesions or pathogens, TCM is guided by functionalism, focusing on the “functional state”. For example, the TCM syndrome “Pi Qi Xu” (Spleen Qi Deficiency) does not denote an organic lesion of the anatomical spleen but rather describes a functional state characterized by impaired digestion and absorption, disordered energy metabolism, and immune

dysregulation (Wang et al., 2020). Given these epistemological differences, TCM diagnostic and therapeutic approaches are frequently conceptualized as a “black-box” system from the perspective of modern medicine: its inputs are macroscopic symptom patterns (pulse, tongue appearance, and patient complaints), and its outputs are TCM-specific interventions such as herbal formulas or acupuncture. The intervening pathophysiological mechanisms and active pharmacological constituents, however, have long remained obscure. This “black-box” characterization consequently poses challenges for TCM within the framework of modern medicine, which places a premium on Evidence-Based Medicine (EBM) — the rigorous scientific evaluation of clinical efficacy to determine treatment validity (Cui et al., 2025). Furthermore, in contemporary healthcare, patients increasingly seek not only confirmation of efficacy but also a mechanistic explanation, raising expectations for greater transparency in TCM. Therefore, elucidating the mechanisms of TCM for AR from a modern medical perspective is crucial to addressing these challenges. Such research, by gradually illuminating this "black box", would not only advance TCM itself but also inform the development of novel therapeutic strategies and drugs, thereby facilitating its internationalization and modernization.

1.3. Contemporary Medical Insight into the Key Pathogenic Mechanisms of Allergic Rhinitis

The pathogenesis of allergic rhinitis (AR) involves multiple interrelated systems, including the gut microbiota, nasal epithelium, immune and inflammatory pathways, and neural regulation (Greiner et al., 2011). This complex process is initiated by dysregulation of the “gut-nose axis” (Nunez et al., 2025; Wang et al., 2025). The gut microbiota plays a crucial role in maintaining immune homeostasis (Salem et al., 2018). Dysbiosis can trigger immune dysregulation (Lyu et al., 2022), thereby predisposing individuals to AR.

The nasal mucosal epithelium is central to the AR pathological process (Chang et al., 2025). When the mucosal barrier integrity is compromised, epithelial cells release alarmins (e.g., IL-33, TSLP, IL-25) to orchestrate repair and inflammatory responses (Nur Husna et al., 2021). Allergens like house dust mites facilitate this by either directly damaging the epithelial barrier via proteases (e.g., Der p 1) or activating pattern recognition receptors (e.g., Der p 2). These alarmins serve as upstream regulators that promptly activate type 2 innate lymphoid cells (ILC2s), which in turn secrete IL-5, IL-13, and IL-4. This initiates the type 2 adaptive immune response, promotes IgE class switching, and culminates in a cascading mucosal inflammatory reaction (Bousquet et al., 2020). Epithelial cell death pathways, including apoptosis, pyroptosis, and autophagy, also contribute to AR development, though their precise roles require further elucidation.

These alarmins drive the immune system into a phase of antigen-specific sensitization and response amplification. TSLP promotes dendritic cell-mediated polarization of naïve T cells into pathogenic Th2 (particularly Th2A) cells, while IL-33 directly activates ILC2s. These parallel pathways converge on the massive secretion of IL-4, IL-5, and IL-13 (Niu et al., 2025). IL-4 and IL-13 induce immunoglobulin class switching in B cells to generate antigen-specific IgE, which binds to high-affinity receptors on mast cells and basophils, completing sensitization.

Upon re-exposure, allergen cross-linking of IgE-bound receptors triggers instantaneous mast cell degranulation and the release of histamine, leukotrienes, and prostaglandin D₂, triggering the acute onset of clinical symptoms. The intensity and persistence of symptoms are critically modulated by a complex neuroimmune network. Histamine stimulates trigeminal nerve endings, sending impulses to the medullary “sneeze center” to elicit sneezing. Concurrently, activated sensory nerves release substance P and CGRP via an axon reflex, directly acting on mast cells and endothelium to cause vasodilation, plasma exudation (nasal congestion), and further immune cell activation, forming a neurogenic inflammatory positive-feedback loop. Furthermore, parasympathetic reflex activation of the sphenopalatine ganglion releases acetylcholine and VIP, a key autonomic mechanism underlying watery rhinorrhea and refractory nasal obstruction (Seijo-Martinez et al., 2006).

Ultimately, recurrent acute episodes evolve into chronic inflammation and tissue remodeling. Sustained IL-5-mediated eosinophil recruitment primes the nasal mucosa, resulting in a state of heightened sensitivity (the “priming effect”) where even minimal stimuli can trigger symptoms. Persistent type 2 inflammatory microenvironment triggers goblet cell hyperplasia, basement membrane thickening, subepithelial fibrosis, and neovascularization in the nasal mucosa. Although these structural changes are typically less severe in AR than in asthma, they form the pathological basis for persistent mucosal hyperreactivity, ultimately rendering AR a chronic, systemic disorder that is difficult to cure (Wang et al., 2025).

1.4. Literature Search Strategy

To ensure the scientific rigor and reliability of this systematic review, a comprehensive literature search was performed across multiple electronic databases, including Google Scholar and the China National Knowledge Infrastructure (CNKI). The search was conducted using a combination of core English keywords: “*Allergic Rhinitis*” AND (“*Traditional Chinese Medicine*” OR “*TCM*”) AND “*Mechanism*”, together with their corresponding Chinese terminological equivalents. To guarantee the novelty and timeliness of the included evidence, only recently published literature was retrieved and screened. Studies that were not directly relevant to the research topic or exhibited insufficient scientific quality and rigor were excluded from the review.

2. Core Mechanisms of TCM in Treating AR from a Modern Medical Perspective

2.1. Modulation of the Gut Microbiota

The regulation of gut microbiota has become a promising therapeutic approach in the management of AR. Accumulating evidence indicates that the mechanisms of several TCM interventions are closely linked to their regulatory effects on intestinal microecology.

In addition to its previously mentioned roles, *Xiaoqinglong Decoction* has been shown to modulate the “gut-lung axis” (Liu et al., 2026). Using high-throughput sequencing, demonstrated that *Xiaoqinglong Decoction* increased the abundance of intestinal *Lactobacillus*, elevated short-chain fatty acid (SCFA) levels, inhibited histone deacetylase (HDAC) activity, and consequently reduced serum IgE and IL-4 levels in a murine model.

Beyond its mucosal actions, research by [10] showed that *Mahuang Fuzi Xixin Decoction* enriches intestinal SCFA-producing bacteria (e.g., *Butyricicoccus*), modulates the Treg/Th17 balance, and lowers IgE and histamine levels.

Furthermore, ingredients such as *Lycium barbarum* (goji berry) and *Astragalus membranaceus* (huangqi) have been reported to exert prebiotic effects, stimulating the growth of *Bifidobacterium* and *Lactobacillus*, boosting SCFA production, and thereby promoting nasal immune tolerance via the gut-nose axis (Liu et al., 2026).

2.2. Protecting the Mucosal Barrier via Modulation of Programmed Cell Death

Recent research indicates that TCM can mitigate allergic rhinitis by regulating key forms of programmed cell death (PCD)—namely, apoptosis, pyroptosis, autophagy, and ferroptosis .

2.2.1. TCM Monomers

Polygonum cuspidatum (Huzhang) has the effects of promoting diuresis to relieve jaundice, clearing heat and detoxifying, and resolving stasis to relieve pain. Its active component, polydatin, can inhibit pyroptosis. [11] confirmed that polydatin activates the PINK1-Parkin pathway to promote mitophagy.

Vitex negundo var. cannabifolia (Mujingzi) has the effect of resolving phlegm and descending qi. [12] found that vitexin, the main active component of *Vitex negundo var. cannabifolia*, can protect nasal mucosal injury by activating the Sirt1/FoxO1 signaling pathway and inhibiting ferroptosis.

Glycyrrhiza uralensis (Gancao), a commonly used TCM for AR treatment, contains 18 β -glycyrrhetic acid. [13] found that 18 β -glycyrrhetic acid inhibits epithelial cell autophagy.

Psoralea corylifolia (Buguzhi) exerts the therapeutic effects of tonifying the kidney to support yang, securing essence to reduce urination, descending qi for asthma relief, and warming the spleen to alleviate diarrhea. [14] studied its active component, bavachin, and found that it can reduce NLRP3-mediated pyroptosis, promote barrier repair by inhibiting the PI3K/Akt/NF- κ B pathway.

Gleditsia sinensis spine (Zaojiaoci) has the effects of promoting the drainage of toxins, antiparasitic effects. [15] found that the extract of *Gleditsia sinensis* spine can inhibit MUC5AC mucin production induced by IL-4/IL-13 through the STAT3/STAT6 pathway, and alleviate mucus hypersecretion to protect the mucosa.

Panax notoginseng (Sanqi) exerts the therapeutic effects of resolving stasis to stop bleeding, as well as reducing swelling to relieve pain. [16] found that its active component, notoginsenoside, can inhibit epithelial cell apoptosis and pyroptosis through AMPK/Drp1/NLRP3 and AMPK/Drp1/Caspase-3 pathways, thereby protecting the mucosa.

Meanwhile, triptolide (from *Tripterygium wilfordii*, Leigongteng) and baicalein (from *Scutellaria baicalensis*, Huangqin) have been confirmed to promote eosinophil apoptosis, thereby inhibiting inflammation and protecting the mucosa.

2.2.2. TCM Formulas

Mahuang Fuzi Xixin Decoction, a famous formula from Zhongjing, consists of *Ephedra sinica*, *Aconitum carmichaelii*, and *Asarum heterotropoides*, with the effects of supporting yang and consolidating the exterior. found that it inhibits NLRP3/Caspase-1/GSDMD-N pathway-mediated pyroptosis of nasal epithelial cells. Network pharmacology analysis of Mahuang Fuzi Xixin Decoction has revealed that its core active ingredients, such as naringenin, genkwanin, and deoxyandrographolide, can alleviate allergic rhinitis by modulating the PI3K-AKT and AMPK signaling pathways to suppress inflammatory mediator release (Cao et al., 2025).

Yupingfeng San, a classic TCM formula, contains *Saposhnikovia root*, *Astragalus membranaceus*, and *Atractylodes macrocephala*, exerting the effects of replenishing qi, consolidating the exterior, and arresting sweating. found that it inhibits mitochondrial reactive oxygen species (ROS) and the NLRP3 pathway, and downregulates Caspase-1 levels. confirmed that YPF+ (Yupingfeng San-derived component) can improve nasal mucosal injury in rats and alleviate AR symptoms such as sneezing, nasal itching, and rhinorrhea. Similarly, the specific material basis of Yupingfeng San has been identified through network pharmacology, highlighting active compounds like calycosin, formononetin, and quercetin. These specific ingredients synergistically target the TNF and MAPK signaling pathways to repair the mucosal barrier and restore immune homeostasis (Z. Liu et al., 2022).

Linggui Zhugan Decoction, originating from *Jin Kui Yao Lue (Synopsis of the Golden Chamber)*, is composed of *Poria cocos*, *Cinnamomum cassia*, *Atractylodes macrocephala*, and *Glycyrrhiza uralensis*, exerting the therapeutic effects of warming yang to disperse fluid retention, invigorating the spleen, and promoting diuresis. demonstrated through an AR rat model that it downregulates the expression of MUC5AC and MUC5B, thereby promoting nasal mucosal tissue repair. For *Linggui Zhugan Decoction*, network pharmacology studies indicate that active compounds including cinnamaldehyde, glycyrrhizic acid, and atractylenolide can regulate oxidative stress and restore immune balance via multi-target inflammatory mechanisms (Yu et al., 2023).

Xinhuan Decoction is one of the classic TCM formulas, with *Magnolia biondii* and *Astragalus membranaceus* as the main herbs, and it has the effects of tonifying qi and unblocking the nasal orifices. confirmed that *Xinhuan Decoction* can downregulate the expression of Cyt-c, Caspase-3, and PARP in mucosal tissue, thereby alleviating mucosal lesions.

Xiaoqinglong Decoction, derived from the classic TCM work *Shang Han Lun (Treatise on Febrile Diseases)*, consists of *Paeonia lactiflora*, *Cinnamomum cassia*, *Ephedra sinica*, *Zingiber officinale* (dried), *Asarum heterotropoides*, *Glycyrrhiza uralensis*, *Pinellia ternata*, and *Schisandra chinensis*. found that *Xiaoqinglong Decoction* can regulate the NLRP3/Caspase-1/GSDMD-N pathway, reduce the proliferation of nasal mucosal goblet cells, mast cell infiltration, and collagen fiber hyperplasia, and downregulate the expression of IL-4, IL-5, and IL-13 in serum and nasal mucosa. Furthermore, recent network pharmacology and molecular docking studies have elucidated the material basis of *Xiaoqinglong Decoction*. Core active ingredients such as ephedrine, quercetin, and paeoniflorin exert synergistic effects by directly

intervening in the TLR4/NF- κ B signaling pathway to reduce allergic inflammation (Yang et al., 2025).

Yiqi Jiemin Decoction is a clinical empirical formula for treating allergic rhinitis with lung-spleen qi deficiency syndrome, developed by multiple experts in the Department of Otorhinolaryngology, the First Clinical Medical College of Beijing University of Chinese Medicine, through clinical practice (Dong, 2024). It is modified from *Xiaoqinglong Decoction* and *Yupingfeng San*, including herbs such as *Astragalus membranaceus*, stir-fried *Atractylodes macrocephala* with bran, *Saposhnikovia root*, honey-fried *Ephedra sinica*, *Cinnamomum cassia*, white *Paeonia lactiflora*, *Zingiber officinale* (dried), *Schisandra chinensis*, *Asarum heterotropoides*, *Magnolia biondii*, *Bupleurum chinense*, *Cicada slough*, and honey-fried *Glycyrrhiza uralensis*. Clinical practice has confirmed its significant efficacy (Yan et al., 2017). Yan et al. (2018) found that *Yiqi Jiemin Decoction* can effectively reduce VAS, TNSS, RQLQ, and nasal sign scores, reduce nasal secretions, and play a role in protecting the mucosa.

2.2.3. External Therapy

Traditional Chinese medicine (TCM) catgut embedding therapy exerts a favorable therapeutic effect on AR. Relevant studies have demonstrated that catgut embedding at the Yingxiang (LI20) acupoint can upregulate the expression of tight junction proteins Claudin-1 and Occludin, thereby enhancing the nasal mucosal barrier. Furthermore, this therapy can decrease the level of Osteopontin (OPN) in lung tissue and retard airway remodeling.

2.3. Regulation of Immune Homeostasis

The core mechanism of some TCM monomers, TCM formulas, and TCM external therapies lies in correcting immune dysregulation in AR patients, which is mainly manifested by inhibiting Th2 and Th17 responses, enhancing Th1 and Treg functions, and directly blocking the production and action of IgE.

2.3.1. Single Chinese Herbs and Their Active Components

Lonicera japonica (Jinyinhua), according to TCM theory, exerts the therapeutic effects of clearing heat to detoxify, as well as dispersing wind-heat. *Lonicera japonica* inhibits the occurrence of allergic reactions by reducing specific IgE levels and suppressing histamine release from mast cells. Its polysaccharides can inhibit splenic Th17 differentiation and decrease IL-17 levels (Liu et al., 2026). Meanwhile, Jian et al. (2017) observed that mice in the *Lonicera japonica* treatment group exhibited significantly reduced nose rubbing, sneezing, and rhinorrhea compared with the model group. Moreover, the eosinophil count in nasal mucosal pathological sections was markedly reduced, the serum concentrations of IL-4, IL-17, and sIgE were significantly decreased, and the expression of IL-17 mRNA and protein in tissues was suppressed, while the serum levels of IL-2 and IFN- γ were elevated. These results suggest that *Lonicera japonica* can modulate the expression of inflammatory factors in sensitized mice and exert a regulatory effect on immune function.

Astragalus membranaceus (Huangqi) has the effects of tonifying qi and elevating yang, benefiting the defensive qi and consolidating the exterior, promoting diuresis to reduce swelling,

generating fluid to quench thirst, activating stagnation to unblock obstruction, removing toxins and draining pus, and astringing sores to promote granulation. *Astragalus membranaceus* can regulate Th17/Treg cells and related inflammatory factors. found that astragaloside IV can effectively alleviate symptoms of allergic rhinitis in mice, reduce nasal mucosal tissue damage, decrease Th17 cells, and increase Treg cells in peripheral blood; this component can also significantly regulate the levels of IL-10, IL-6, IL-17, IgE, and TGF- β 1 in the serum of allergic rhinitis mice, as well as effectively downregulate the expression levels of IL-17 and TGF- β mRNA in the nasal mucosal tissue of allergic rhinitis mice. Moreover, astragalus polysaccharide contained in *Astragalus membranaceus* also has a good curative effect on reducing the inflammatory response of allergic rhinitis, which may be because astragalus polysaccharide can act on the NF- κ B-mediated Treg/Th17 imbalance, thereby effectively reducing the release of inflammatory factors (He et al., 2022).

Scutellaria baicalensis (Huangqin), in line with TCM theory, exerts the therapeutic effects of clearing heat to dry dampness, purging fire to detoxify, and calming the fetus. Baicalein can regulate the balance between regulatory T cells and helper Th17 cells, and inhibit serum histamine and IgE levels (Liu et al., 2026). Yang et al. (2022) found that baicalein treatment significantly reduced the number of sneezes and nose rubbings in AR rats, decreased serum histamine and IgE levels, and alleviated sinus mucosal pathological damage and leukocyte infiltration.

Panax ginseng (Hongshen) has the effects of greatly tonifying primordial qi, restoring pulse and relieving collapse, and benefiting qi to control blood. As one of its active components, ginsenoside Rd can inhibit immune cell activation. Kim et al. (2019) found that ginsenoside Rd can inhibit the expression of IL-4, IL-5, and IL-13 in the colon of OVA-sensitized mice, reduce the frequency of rubbing/scratching, and alleviate nasal mucosal inflammation.

Ephedra sinica (Mahuang) has the effects of inducing diaphoresis to relieve exterior syndrome, dispersing cold to unblock stagnation, dispersing the lung to relieve asthma, and promoting diuresis to reduce swelling. Its main active components include ephedra polysaccharide, which has the effect of regulating the balance of helper T cells. found that ephedra polysaccharide promotes the secretion of miR-146a-5p, increases IFN- γ and decreases IL-4 in AR rats through Smad3/GATA-3 interaction, and promotes the pathological repair of nasal mucosa(Liu et al., 2026).

Amomum villosum (Sharen) can resolve dampness to stimulate appetite, warm the middle to stop diarrhea, and regulate qi to prevent abortion; it has the effects of regulating Th1/Th2 balance and inhibiting mast cell degranulation. confirmed through experiments that its internal volatile oil components can reduce the frequency of nose rubbing and sneezing in AR mice, inhibit NF- κ B phosphorylation, and alleviate inflammation in nasal and lung tissues.

Magnolia biondii (Xinyi) can disperse wind-cold, unblock nasal orifices, and has antihistamine, anti-allergic, and immune homeostasis-maintaining effects. The volatile oil components in *Magnolia biondii* can inhibit inflammation, reduce the release of inflammatory mediators such as IL-1 and tumor necrosis factor (TNF) in the downstream signaling pathway of TLRs, inhibit the

number and activity of eosinophils and mast cells, and suppress T cell activation and mast cell aggregation, thereby improving AR symptoms in patients (Choi et al., 2021). Meanwhile, a study (Hu et al., 2021) found that its volatile oil components can reverse the Th1/Th2 imbalance in the peripheral blood of AR guinea pigs, decrease the levels of IL-4 and IFN- γ , and maintain immune dynamic balance.

Salvia miltiorrhiza (Danshen), according to TCM theory, exerts the therapeutic effects of promoting blood circulation to eliminate blood stasis, unblocking meridians to alleviate pain, clearing the heart to calm the mind, and cooling blood to resolve carbuncles. Its tanshinone IIA component can inhibit Th2 cytokines. It can also reduce histamine release from mast cells by inhibiting the NF- κ B pathway, thereby alleviating AR reactions.

Asarum heterotropoides (Xixin), in line with TCM theory, exerts the therapeutic effects of relieving exterior cold, dispelling wind to ease pain, unblocking orifices, and warming the lung to disperse fluid retention. The internal volatile oil components of this herb can regulate the distribution of T lymphocyte subsets, reduce the ratio of T helper cells Th1/Th2, and restrain the production of endorphins and interferons. Experiments have shown that it can regulate the distribution of T lymphocyte subsets, decrease the Th1/Th2 ratio, and inhibit the formation of specific IgE.

2.3.2. TCM Formulas

Chuanxiong Chatiao San, derived from *Taiping Huimin Heji Ju Fang* (Formulas of the Peaceful Benevolent Dispensary), is a classic TCM formula with the effect of dispersing wind to relieve pain, consisting of *Mentha haplocalyx*, *Ligusticum chuanxiong*, *Schizonepeta tenuifolia*, *Asarum heterotropoides*, *Saposhnikovia root*, *Angelica dahurica*, *Notopterygium incisum*, and *Glycyrrhiza uralensis*. *Chuanxiong Chatiao San* can reduce the level of serum ovalbumin-specific IgE (OVA-sIgE) and the expression of related inflammatory factors. Mao et al. (2021) confirmed that this formula significantly increases the mRNA expression of T-bet and STAT1, decreases the expression of GATA3, and reverses Th1/Th2 drift by regulating the JAK/STAT pathway. In the case of *Chuanxiong Chatiao San*, network pharmacology has identified ligustilide, senkyunolide I, and ferulic acid as the primary bioactive components. These ingredients exert anti-inflammatory effects by directly acting on neuro-immune regulation and modulating vascular permeability in the nasal mucosa (Wang et al., 2022).

Gancao Ganjiang Decoction, derived from the classic TCM work *Shang Han Lun* (Treatise on Febrile Diseases), consists of *Glycyrrhiza uralensis* and *Zingiber officinale* (dried), with the effects of transforming yang through acidity and sweetness, and warming the middle to tonify qi. It has the function of regulating cytokine imbalance. found that this formula can increase serum IFN- γ and decrease IL-4 in AR rats, reverse the deviation of Th cell differentiation, and repair the pharyngeal mucosal structure. Furthermore, the material basis of *Gancao Ganjiang Decoction* has been linked to key compounds such as liquiritin, glycyrrhetic acid, and 6-gingerol. Network pharmacology demonstrates that these ingredients synergistically inhibit the NF- κ B signaling pathway and reduce oxidative stress, thereby ameliorating mucosal inflammation (Lee et al., 2021).

Huangqi Guizhi Wuwu Decoction, derived from the classic TCM work *Shang Han Lun* (Treatise on Febrile Diseases), consists of *Astragalus membranaceus*, *Cinnamomum cassia*, fresh *Zingiber officinale*, *Ziziphus jujuba*, and *Paeonia lactiflora*, which can tonify qi and deficiency, warm the meridians to unblock collaterals, and regulate nutritive and defensive qi. Studies have proved that it has a certain immunomodulatory effect. Chen et al. (2020) found that modified *Huangqi Guizhi Wuwu Decoction* can effectively regulate the immune balance of Th1/Th2 and Th17/Treg cells in the body.

Modified *Wuwei Shigao Decoction* is developed by Liu by adding *Magnolia biondii* to *Wuwei Shigao Decoction* from *Sisheng Xinyuan* (Four Sages' Heart Source), including *Schisandra chinensis*, gypsum, *Prunus armeniaca*, *Pinellia ternata*, *Scrophularia ningpoensis*, *Poria cocos*, *Platycodon grandiflorus*, and fresh *Zingiber officinale*; it can disperse with acidity and warmth, unblock orifices with aroma, dispel wind-cold pathogens externally, and ascend and diffuse lung-stomach clear qi internally. Liu et al. (2018) found that this formula can improve the symptoms of AR mice, inhibit the levels of serum IgE, TNF- α , and IL-1 β , and increase serum IFN- γ and nasal mucosal T-bet expression.

Sanfeng Tongqiao Dropping Pills is a Chinese patent medicine used for the treatment of AR, exerting the therapeutic effects of clearing heat, dispelling wind, dispersing cold, and unblocking nasal orifices. It is clinically applied to alleviate nasal congestion, runny nose and other related symptoms caused by AR. It has the effect of inhibiting type II immune response. Through network pharmacology and experiments, Sun et al. (2023) confirmed that it acts on the T cell receptor and HIF-1 α pathway, reduces the levels of IL-4 and IL-13, and stabilizes the mast cell membrane.

Lu'e Biyan Formula is an empirical formula by Professor Zhang Shunan from China-Japan Friendship Hospital, consisting of deer antler glue, *Centipeda minima*, *Stellaria dichotoma*, *Prunus mume*, *Saposhnikovia root*, *Tribulus terrestris*, *Xanthium sibiricum*, and *Glycyrrhiza uralensis*, with the effect of warming yang and unblocking nasal orifices. The research teams led by Jia et al. (2022) and Yan Jiabin found that *Lu'e Biyan Formula* restores the balance of Th1/Th2 and Th17/Treg by inhibiting the Notch1-Jagged1 signaling axis (Yan et al., 2024).

Yiqi Wenyang Formula, consisting of *Astragalus membranaceus*, *Codonopsis pilosula*, *Zingiber officinale* (dried), *Cinnamomum cassia*, *Ephedra sinica*, *Schisandra chinensis*, *Pheretima aspergillum*, *Magnolia biondii*, and *Glycyrrhiza uralensis*, is an empirical formula by Professor Yan Daonan, a renowned TCM doctor in Jiangsu Province, with the effects of tonifying qi, warming yang, and dispersing the lung to unblock nasal orifices. Shi et al. (2014) found that this formula promotes the increase of Treg cells in the body, increases the levels of IL-10 and TGF- β 1, and inhibits IL-4 and IL-13 produced by Th2, thereby alleviating AR symptoms.

In addition, some self-designed formulas treat AR by regulating immune mechanisms (Gu et al., 2025). *Wenfei Yiqi Formula* improves AR symptoms and promotes the recovery of nasal function by regulating the balance of Th1/Th2 and Th17/Treg cells (Jiang et al., 2023). *Yiqi Gufei Qufeng Formula* reduces the recurrence of AR by improving immune function and alleviating inflammatory response (Fan et al., 2023). *Buqi Sanhan Formula* exerts its therapeutic effect on

AR by reducing the levels of serum total IgE, specific IgE, and IL-17A (Li et al., 2022). *Majie Formula* inhibits the expression of IgE by B cells through the IL-4 and IL-13 signaling pathways, thereby exerting a therapeutic effect on AR (Wu et al., 2020).

2.3.3. External Therapy

Studies (Kim et al., 2022; Li et al., 2024; Li et al.; Zhang et al., 2022; Zhu et al., 2024) have reported that the mechanisms of some TCM external therapies in the treatment of AR are related to immune regulation. Acupuncture (body acupuncture) can effectively improve the symptoms of allergic rhinitis (AR), reduce eosinophil count, and serum levels of IL-4, IL-5, IgE, and sIgE. Heavy moxibustion at acupoints can improve nasal obstruction in AR patients by reducing serum IL-33 and EOS levels. Zhang et al. found that thunder-fire moxibustion significantly reduces IgE and IL-10 levels. Ear acupoint pressing has the effect of activating the "periphery-central-target organ" regulatory mode. Its mechanism involves inhibiting the differentiation of Th1 to Th2 and reducing IgE synthesis through the stimulation of vagus nerve fibers in the cavum conchae (tVNS).

2.4. Regulation of Inflammatory Signaling Pathways

Certain TCM monomers, TCM formulas, and TCM external therapies can intervene in signaling pathways including TLRs, NF- κ B, MAPK, and JAK/STAT to treat allergic rhinitis.

2.4.1. TCM Monomers

Tripterygium wilfordii (Leigongteng), in TCM theory, has the effects of dispelling wind and dampness, promoting blood circulation to unblock collaterals, reducing swelling and relieving pain, and killing insects and detoxifying. *Tripterygium wilfordii* possesses immunosuppressive and anti-inflammatory effects. Chen et al. (2020) confirmed that triptolide, an active component in *Tripterygium wilfordii*, reduces serum total IgE and histamine levels through the TLR4/NF- κ B pathway, downregulates IL-4 expression in the nasal mucosa of AR rats, decreases TGF- β 1 secretion by EOS, and regulates Th1/Th2 balance.

Lycium barbarum (Gouqi), in TCM theory, has the effects of nourishing the liver and kidney, and benefiting essence to improve eyesight. Its main active component, Lycium barbarum polysaccharide (Xie et al., 2024), exerts an immunomodulatory effect (Xiao et al., 2022). Wang et al. (2024) found that it corrects Th1/Th2 imbalance and alleviates nasal mucosal inflammation by inhibiting the expression of proteins related to the TLR/NF- κ B signaling pathway.

Saposhnikovia root (Fangfeng) has the effects of dispelling wind to relieve exterior syndrome, overcoming dampness to relieve pain, and relieving spasm. Among them, saposhnikovia polysaccharide is its main active component. Ren et al. (2023) found that saposhnikovia polysaccharide can inhibit the NF- κ B/STAT3 signaling pathway, promote AQP5 expression, and improve the pathological morphology of AR rats. In addition, He et al. (2024) found that saposhnikovia polysaccharide can significantly promote macrophages to release NO, TNF- α , and IL-6, increasing the density of immune cells and the number of macrophages.

Rheum palmatum (Dahuang), according to TCM theory, exerts the therapeutic effects of purging intestines to relieve accumulation, clearing heat to purge fire, cooling blood to detoxify,

stopping bleeding, removing blood stasis to unblock meridians, and promoting diuresis to alleviate jaundice. Studies have found that its extracted component, emodin, can downregulate miR-375 and promote KLF5 expression, thereby inhibiting the inflammatory response in AR mice.

Both *Paeonia lactiflora* (Chishao, red peony root) and *Paeonia lactiflora* (Baishao, white peony root) are rich in paeoniflorin. Paeoniflorin has anti-inflammatory and immunomodulatory effects. Studies have confirmed that paeoniflorin regulates cellular immune balance by increasing IFN- γ levels and decreasing the levels of IL-33, ST2, TGF- β 1, ICAM-1, IL-4, and IgE (Wang et al., 2016). Meanwhile, He et al. (2024) found that paeoniflorin can inhibit oxidative stress closely related to immune response, regulate cellular autophagy, and maintain Th1/Th2 balance.

2.4.2. TCM Formulas

Cang'er Wendan Decoction consists of *Poria cocos* (Poria), *Xanthium sibiricum* (Xanthii Fructus), processed *Pinellia ternata* (Qingbanxia, prepared Pinellia tuber), bamboo shavings processed with ginger (Jiangzhuru, ginger-processed bamboo shavings), *Angelica dahurica* (Baizhi), *Citrus reticulata* peel (Chenpi, dried tangerine peel), stir-fried *Aurantii Fructus* with bran (Fuchaoshis hi, bran-stir-fried Aurantii Fructus), *Mentha haplocalyx* (Bohe, peppermint), *Magnolia biondii* (Xinyi, Biond Magnolia Flower), and raw *Glycyrrhiza uralensis* (Shenggancao, raw Liquorice). Li et al., (2025) found that *Cang'er Wendan Decoction* controls allergic rhinitis by inhibiting the TLR4/MyD88/NF- κ B signaling pathway, reducing the levels of IgE and IL-6, and increasing IL-10 levels.

Huanglian Jiedu Decoction, derived from *Zhouhou Beiji Fang* (Emergency Prescriptions Worth a Thousand Gold), is a classic TCM formula composed of *Coptis chinensis* (Huanglian, Coptis Root), *Scutellaria baicalensis* (Huangqin, Baical Skullcap Root), *Phellodendron chinense* (Huangbai, Amur Corktree Bark), and *Gardenia jasminoides* (Zhizi, Cape Jasmine Fruit), which can clear fire from the triple jiao. Liu et al. (2021) found that *Huanglian Jiedu Decoction* reduces the proportion of nasal mucosal goblet cells by inhibiting the TLR4/NF- κ B signaling pathway.

Biyuan Tongqiao Granules is a commonly used Chinese patent medicine with the effects of dispersing wind-heat and diffusing the lung to unblock nasal orifices. Chai et al. (2025) showed that this granule can target PTGS2, MAPK, and HIF-1 signals by inhibiting the TLR4/NF- κ B signaling pathway, regulate Th cell balance, and reduce the levels of IL-4 and TNF- α .

Jingfang Granules is a commonly used Chinese patent medicine with the effects of inducing diaphoresis to relieve exterior syndrome and dispersing wind to eliminate dampness. found that *Jingfang Granules* can regulate the endoplasmic reticulum stress signaling pathway (GADD, ATF4, p-eIF2 α), inhibit metabolic and inflammatory pathways, thereby controlling allergic rhinitis.

Bimin Formula consists of *Astragalus membranaceus* (Huangqi), *Atractylodes macrocephala* (Baizhu), *Saposhnikovia root* (Fangfeng), *Cinnamomum cassia* (Guizhi), *Paeonia lactiflora* (Baishao, white peony root), *Cicada slough* (Chanyi), *Pheretima aspergillum* (Dilong), *Angelica dahurica* (Baizhi), *Asarum heterotropoides* (Xixin), *Siegesbeckia orientalis* (Xixiancao), *Cynanchum paniculatum* (Xuchangqing), *Terminalia chebula* (Hezi), and raw *Glycyrrhiza*

uralensis (Shenggancao). It exerts anti-inflammatory and anti-allergic effects and improves AR symptoms by regulating the transmembrane protein 16A (TMEM16A)/MUC5AC/NF- κ B/Th17/IL-17A signaling pathway and related factors (Shi et al., 2024; Xu et al., 2024).

2.4.3. External Therapy

Studies have reported that acupoint application and acupoint injection can regulate inflammatory pathways (Xin & Ming, 2025). Jin et al. (2018) found that acupoint application significantly reduces nasal mucosal inflammatory cell infiltration by inhibiting the TLR4/NF- κ B pathway. Meanwhile, acupoint injection can downregulate the expression of histamine receptors H1R and H4R; Zhou confirmed that it corrects Th1/Th2 imbalance through the TLR4/AP-1 pathway. In addition, it can also inhibit p38 MAPK phosphorylation and reduce MUC5AC secretion.

2.5. Neuro-Immune Regulation

The main mechanism of some TCM monomers and TCM external therapies in the treatment of AR lies in the intervention of neuropeptide release and neuroreceptors, which are introduced as follows.

2.5.1. TCM Monomers

Ephedra sinica (Mahuang), an exterior-releasing herb, has the effects of inducing diaphoresis to relieve exterior syndrome, dispersing the lung to relieve asthma, promoting diuresis to reduce swelling, and dispersing cold to unblock stagnation. Ephedrine is one of its main active components. Ling et al. (2022) found that it regulates the Th2-type immune response in AR rats through the TSLP/OX40L pathway. Meanwhile, in addition to the functions mentioned earlier, modern pharmacological studies have found that the volatile oil of *Magnolia biondii* (Xinyi) can counteract neurogenic vasodilation (Liang et al., 2011), constrict nasal mucosal blood vessels, inhibit the release of IL-1 and TNF- α downstream of TLRs, and alleviate neurogenic edema.

2.5.2. External Therapy

Acupuncture has a significant therapeutic effect on AR through the regulation of the nervous system (Xiao & Xu, 2025). Intranasal acupuncture (at Neiyangxiang/EX-HN9 and nasal concha) has the effect of rapidly improving the allergic state of the nasal mucosa. Studies confirmed that it reduces TRPV1 activity and blocks the release of neuropeptides through the "axon reflex". Meanwhile, acupuncture at the nasal concha increases NPY levels, effectively constricting blood vessels and relieving nasal obstruction. Studies found that after acupuncture, the serum IgE level of patients and the contents of SP and VIP in nasal secretions decreased significantly. Meanwhile, Tian found that acupuncture at the sphenopalatine ganglion (Xinwu point) has a direct effect on regulating the neurofunction of the nasal mucosa. It inhibits the TLR4/MyD88/NF- κ B pathway and effectively balances the Th1/Th2 and Treg/Th17 systems. Catgut embedding therapy has long-acting physical stimulation and neuroregulatory effects; studies have found that it inhibits the conduction of C-type sensory fibers and reduces the release of SP, CGRP, and VIP through the "Yingxiang (LI20)-trigeminal nerve-sphenopalatine ganglion" pathway.

3. Summary and Outlook

3.1. Mechanism Review: Biological Basis of Systematic Intervention

Research on the mechanisms of TCM in treating allergic rhinitis has transcended the superficial level of symptom alleviation and probed into the in-depth logic of the body's regulatory network. From the perspective of modern systems biology, the TCM theory focusing on syndrome differentiation and treatment has been specifically deconstructed into the synergistic effects of multiple dimensions, including the regulation of the microecological axis, the repair of cellular barriers, the regulation of immune homeostasis, the blocking of inflammatory signals, and neuro-immune regulation.

These five mechanisms do not exist in isolation but exhibit a highly coupled network relationship. For example, the remodeling of intestinal microecology can distally regulate the function of Treg cells through the "gut-nose axis", thereby promoting the recovery of immune homeostasis; the improvement of the immune environment can reduce the attack of inflammatory mediators on the nasal mucosal epithelium, creating conditions for the repair of the physical barrier. This multi-target, multi-level dynamic regulatory mechanism effectively corrects the abnormal biological network state of AR patients, establishing a solid biological basis for TCM in the treatment of AR. However, despite significant progress in the exploration of micro-mechanisms, TCM still faces multiple challenges from theoretical cognition to clinical evaluation paradigms when attempting to integrate into the mainstream modern medical system dominated by reductionism.

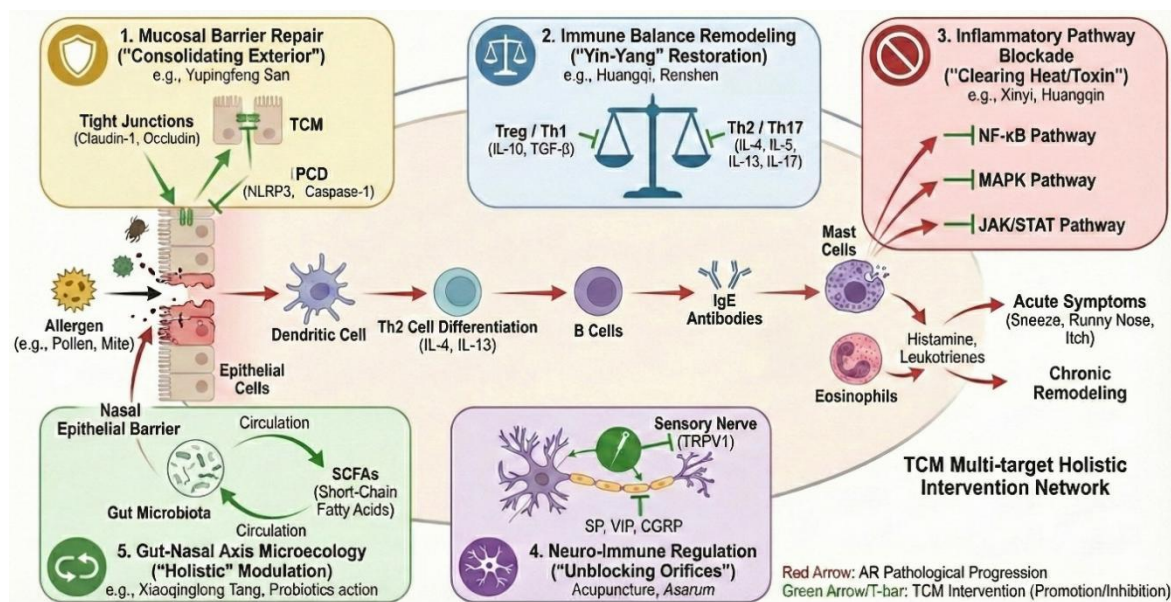


Figure 1. Panoramic View of Allergic Rhinitis Pathogenesis and TCM Regulatory Targets

3.2. Strategic Synergy and Clinical Value of Integrated Traditional Chinese and Western Medicine (TCM-WM) with Complementary Advantages

The integrated TCM-WM treatment of allergic rhinitis is not a simple superposition of two medical systems, but an in-depth integration and strategic synergy based on their respective

advantages, aiming to solve clinical bottlenecks that are difficult to overcome with a single therapy. Modern conventional Western medicine treatment, based on the ARIA guidelines, takes second-generation antihistamines, nasal glucocorticoids, and leukotriene receptor antagonists as the cornerstone. With its strong anti-inflammatory and anti-allergic effects, it can quickly control acute symptoms such as nasal obstruction and rhinorrhea within hours, serving as a vanguard in the acute attack stage of AR. However, Western medicine treatment often faces the dilemma of recurrence after drug withdrawal; long-term use of hormones may lead to nasal mucosal atrophy, drug-induced rhinitis, and corticosteroid resistance, and some patients cannot tolerate the somnolent side effects of antihistamines. In contrast, relying on the holistic concept and syndrome differentiation and treatment, TCM has unique advantages in regulating immune imbalance, improving allergic constitution, and preventing recurrence. This complementary strategy of "treating acute symptoms urgently and addressing the root cause in remission" constitutes the core of the clinical value of integrated TCM-WM.

Evidence-based medicine strongly supports the superiority of this synergistic effect. Large-scale Meta-analysis (Zhu & Zhang, 2022) has shown that TCM decoction combined with conventional Western medicine in the treatment of AR is not only superior to the single Western medicine group in short-term symptom control, but also significantly improves the long-term effective rate (RR=1.79), indicating that combined treatment can effectively break the vicious cycle of the inflammatory cascade reaction. Especially in terms of controlling the recurrence rate, the combination of exterior-consolidating preparations such as *Yupingfeng San* and loratadine can significantly reduce the six-month recurrence rate of AR from 41.7% in the single Western medicine group to 23.1% (Tong & Yan, 2025), with no serious adverse reactions, achieving the clinical goal of reducing toxicity and enhancing efficacy. In addition, for patients with refractory AR or severe nasal obstruction, integrated TCM-WM provides more dimensional intervention methods. For example, when Western medicine control is poor, the introduction of acupuncture at the sphenopalatine ganglion or the use of aromatic orifice-unblocking drugs such as *Cang'erzi San* can instantly relieve nasal obstruction caused by severe mucosal edema by improving local microcirculation and regulating neurogenic inflammation, making up for the limitations of Western medicine in certain pathological links. To enhance the clinical translational value of TCM interventions, it is recommended to establish precision application scenarios by matching modern clinical classifications (e.g., seasonal or perennial) and severity grading (e.g., mild, moderate, or severe) with TCM syndrome differentiation.

In the context of modern network pharmacology, the efficacy of TCM formulas in treating AR is not a mere enumeration of independent compounds, but a highly coordinated synergistic network. Within this network, core active ingredients exhibit clear priority and dynamic crosstalk, closely mirroring the traditional TCM principle of "Sovereign-Minister-Assistant-Courier" (Jun-Chen-Zuo-Shi) (Shao & Zhang, 2013; Wang et al., 2021). Through topological analysis, components with the highest degree centrality (Hub nodes, such as quercetin) often act as the "Sovereign" (Jun) by broadly modulating extensive upstream immune networks and the gut-nose axis. Concurrently, "Minister" (Chen) components (such as ephedrine and paeoniflorin in *Xiaoqinglong Decoction*) exhibit synergistic actions by targeting specific downstream

inflammatory cascades (e.g., TLR4/NF- κ B). This interaction forms a multi-level dual-blockade—one component may enhance mucosal permeability to promote the absorption of another, while simultaneously acting on parallel signaling pathways to prevent inflammatory evasion (Wang et al., 2021). Thus, clarifying these hub nodes and their crosstalk mechanisms provides a precise material basis for the multi-target synergy of TCM.

From an integrated medicine perspective, modern microscopic mechanisms often correspond to macroscopic TCM syndromes. For example, mucosal barrier damage may be understood as an insufficiency of healthy Qi (Zhengqi deficiency); while gut microbiota dysbiosis is closely related to Spleen and Stomach weakness. This echoes the classical TCM theory in the Miraculous Pivot (Lingshu) that "man receives Qi from grain, which enters the stomach and is transmitted to the lungs." Therefore, individualized treatments can be optimized based on these mappings and clinical severity. For mild or seasonal AR, which often presents with Zhengqi deficiency, therapies focusing on mucosal repair and barrier consolidation, such as Yupingfeng San or acupoint catgut embedding, are generally preferred to prevent recurrence. Conversely, for moderate-to-severe AR during the acute exacerbation phase, rapid symptom control is often necessary. Symptom-specific formulas (e.g., Xiaoqinglong Decoction) or intranasal acupuncture may be utilized to target underlying inflammatory pathways.

Furthermore, when formulating TCM prescriptions, clinicians are encouraged to fully leverage the "multi-component and multi-target" advantages by selecting herbs that act synergistically across diverse, complementary pathways. Concurrently, the excessive combination of herbs competing for the exact same molecular target should be carefully evaluated or avoided, in order to prevent potential competitive inhibition and ensure optimal therapeutic efficacy.

3.3. Existing Problems and Challenges

Although TCM has shown great potential in the treatment of AR, to achieve the leap from traditional empirical medicine to modern scientific medicine, it is still necessary to face a series of severe challenges, among which the lack of standardization and the "mechanism black box" are the core bottlenecks restricting its international development (Dong et al., 2025). Firstly, the specific mechanism of TCM in the treatment of AR is still largely in a black box state. How hundreds of chemical components in compound prescriptions interact with each other at the pharmacokinetic level, how they are transformed in the intestinal flora and exert systematic regulatory effects, currently lacks sufficient in vivo and in vitro experimental verification, making it difficult for TCM to be fully accepted by the modern mainstream medical community accustomed to reductionist thinking.

In addition, the uneven quality of clinical research is also an undeniable problem. Although there are a large number of randomized controlled trials on TCM in the treatment of AR, high-quality, large-sample, multi-center, and strictly blinded Grade A evidence is still scarce. Some studies have defects such as unclear randomization methods and over-reliance on subjective symptom scores for outcome indicators, which reduces the credibility of the conclusions. At the same time, research on safety and drug interactions is relatively lagging behind. Although TCM is generally safe, drugs such as *Asarum heterotropoides* (Xixin) and *Xanthium sibiricum* (Cang'erzi)

have potential risks of liver and kidney toxicity if improperly processed or used in excess; when combined with Western medicine, whether the complex interactions between components will change the pharmacokinetic characteristics of Western medicine currently lacks systematic pharmacological data support.

3.4. Future Outlook: Paradigm Innovation in Standardization, Precision, and Evidence-Based Practice

Faced with the above challenges, the future development of TCM in the treatment of AR will surely evolve along the path of standardization, precision, and evidence-based practice.

In terms of standardization, the international guidelines and expert consensus successively released in 2024 and 2025 are of milestone significance (Fu & Zhang, 2025). By introducing the GRADE evidence grading system, modern TCM is constructing clinical pathways based on rigorous evidence, clarifying the diagnostic criteria for core syndromes such as lung qi deficiency-cold and spleen qi deficiency, and making graded recommendations for therapies such as *Tongqiao Biyan Granules* and acupuncture at the sphenopalatine ganglion. This has ended the previous chaotic situation of "one prescription for thousands of patients" that was difficult to replicate, providing an operable standardized plan for primary medical care.

Precision and personalized treatment are the key growth points for the future breakthrough of TCM, whose core lies in the in-depth integration of TCM syndrome differentiation and modern medical molecular typing.

On the one hand, the combination of Whole Genome Sequencing (WGS) and network pharmacology is revealing the scientific connotation of the multi-target and network-based intervention of TCM compounds. The latest WGS study found that the pathogenesis of AR is closely related to rare gene mutations in the focal adhesion pathway (Zhang et al., 2019), which involves angiogenesis and barrier function. Traditional single-target Western medicine is difficult to cover such complex genetic heterogeneity, while TCM compounds (such as those for qi deficiency and blood stasis) naturally have multi-component characteristics, which can simultaneously intervene in multiple nodes in the network and systematically reshape the focal adhesion pathway. This network-based regulatory mechanism provides a solid genomic basis for explaining the unique efficacy of TCM in patients with familial and refractory AR.

On the other hand, the application of artificial intelligence (AI) and digital twin technology will facilitate the progress and development of TCM's personalized diagnosis and treatment model. The traditional "one patient, one strategy" often relies on the personal experience of doctors, while the future precision TCM can construct virtual patients based on the patient's multi-modal data (Yu et al., 2025) (genome, single-cell sequencing data, tongue manifestation characteristics). AI is used to simulate the dynamic network of cell states in AR patients at different stages such as remission and attack, and conduct high-throughput virtual drug screening and efficacy prediction. For example, AI algorithms can predict the regulatory effect of specific TCM components on ILC2 or pathogenic Th2 cells, and even predict the potential side effects of TCM-WM combination, thereby formulating the optimal precision treatment plan for patients. This "AI +

TCM" model not only avoids the risk of trial and error, but also elevates TCM's personalized treatment to a new level of digitalization and intelligence.

Finally, evidence-based practice will be the touchstone for testing all reform achievements. Future clinical research will no longer be limited to the improvement of subjective symptoms, but will introduce more objective biomarkers as outcome indicators. At the same time, real-world research will become an important tool to evaluate the long-term efficacy and health economics value of TCM, providing solid evidence support for the formulation of medical insurance policies and the global promotion of TCM. In summary, with the in-depth intervention of modern science and technology, TCM is undergoing a profound transformation, and is expected to provide a new treatment strategy with both precision and holistic view for hundreds of millions of AR patients worldwide.

Author Contributions:

Conceptualization, Ziyang Yu and Zhanfeng Yan; writing—original draft preparation, Ziyang Yu; writing—review and editing, Ziyang Yu and Zhanfeng Yan; visualization, Ziyang Yu; All authors have read and agreed to the published version of the manuscript.

Funding:

This research received no external funding.

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable

Data Availability Statement:

Not applicable

Conflict of Interest:

The authors declare no conflict of interest.

References

- Bernstein, J. A., Bernstein, J. S., Makol, R., & Ward, S. (2024). Allergic rhinitis: A review. *JAMA*, 331(10), 866–877.
- Bousquet, J., Anto, J. M., Bachert, C., Baiardini, I., Bosnic-Anticevich, S., Canonica, G. W., Melén, E., Palomares, O., Scadding, G. K., & Togias, A. (2020). Allergic rhinitis. *Nature Reviews Disease Primers*, 6(1), 95.
- Cao, L., Chen, X., Guo, Y., & Feng, Y. (2025). Study on the mechanism of Mahuang Xixin Fuzi decoction in treating allergic rhinitis and prediction of its Q-markers based on network

- pharmacology and molecular docking. *Chinese Medicine and Natural Products*, 5(2), e115–e123.
- Chai, K., Wang, W., Wang, H., Zhang, T., Zhou, J., Li, J., Yang, S., Qiao, C., Guo, X., & Zhang, X. (2025). Efficacy and safety of Biyuan Tongqiao granules in the treatment of allergic rhinitis: A meta-analysis of randomized controlled trials. *Journal of Ethnopharmacology*, 344, 119572.
- Chang, W., He, Y., & Liu, L. (2025). RGS1 induces nasal epithelial barrier dysfunction in allergic rhinitis by modulating NF- κ B/AQP5 axis. *Cytotechnology*, 77(5), 164.
- Chen, J., Huang, D., Zuo, X., Chen, S., & Xian, X. (2020). Regulatory effect of modified Huangqi Guizhi Wuwu decoction on Th1/Th2 and Th17/Treg cellular immune imbalance in rats with allergic rhinitis. *Journal of Guangzhou University of Traditional Chinese Medicine*, 37(7), 1327–1331.
- Chen, T., Dong, L., Wu, Y., Shen, T., Deng, Y., Li, F., & Tao, Z. (2025). Bavachinin alleviates allergic rhinitis by modulating gut microbiota and inhibiting NLRP3-mediated epithelial pyroptosis through PI3K/AKT/NF- κ B signaling pathway. *Cellular Signalling*, 112026.
- Chen, X., Zhong, X., Liang, H., Zhang, X., & Zhou, M. (2020). Effects of triptolide on the expression of TGF- β 1 and IL-4 in nasal mucosa tissue of rats with allergic rhinitis. *Electronic Journal of Clinical Medical Literature*, 1–16.
- Choi, B. Y., Han, M., Kwak, J. W., & Kim, T. H. (2021). Genetics and epigenetics in allergic rhinitis. *Genes*, 12(12), 2004.
- Chun, M., Li, S., Rubin, H., & Yang, L. (2019). Research progress and mechanism of traditional Chinese medicine in the treatment of allergic rhinitis. *Journal of Basic Chinese Medicine*, 25(10), 1473–1476.
- Cui, G., Li, M., Guo, W., Gao, M., Zhu, Q., & Liao, J. (2025). AI-driven network pharmacology: Multi-scale mechanisms of traditional Chinese medicine from molecular to patient analysis. *Computational and Structural Biotechnology Journal*, 27, 5087.
- Ding, M., Wei, X., Liu, C., & Tan, X. (2024). Mahuang Fuzi Xixin decoction alleviates allergic rhinitis by inhibiting NLRP3/Caspase-1/GSDMD-N-mediated pyroptosis. *Journal of Ethnopharmacology*, 327, 118041.
- Dong, B., Xie, L., & Li, Y. (2025). Potential mechanisms of traditional Chinese medicine for the treatment of allergic rhinitis: Evidence from molecular and clinical studies. *International Journal of General Medicine*, 18, 5519–5555.
- Dong, M., Chen, X., Xi, K., Wang, Y., Gui, Y., Zhang, F., Ma, C., Hong, H., Liu, X., & Jiang, Y. (2014). Effects of 18 β -glycyrrhetic acid on mitochondria in nasal mucosal epithelial cells of rats with allergic rhinitis. *Journal of Otolaryngology and Ophthalmology of Shandong University*, 28(3), 1–6.
- Dong, Z. (2024). Multicenter clinical study of Yiqi Jiemin decoction in the treatment of moderate to severe allergic rhinitis (lung-spleen qi deficiency syndrome) [Master's thesis, Beijing University of Chinese Medicine].
- Du, Q., & Wang, X. (2024). Study on the effects of Linggui Zhugan decoction on nasal hypersecretion in rats with allergic rhinitis. *Asia-Pacific Traditional Medicine*, 20(6), 12.

- Fan, Q., Qi, G., Wang, L., & Li, S. (2023). Clinical efficacy of self-made Yiqi Gufei Qufeng formula in the treatment of pediatric allergic rhinitis and its effect on Treg/Th17 balance. *Journal of Sichuan of Traditional Chinese Medicine*, 41(7), 166–169.
- Fan, Y., Nguyen, T. V., Piao, C. H., Shin, H. S., Song, C. H., & Chai, O. H. (2022). Fructus Amomi extract attenuates nasal inflammation by restoring Th1/Th2 balance and down-regulation of NF- κ B phosphorylation in OVA-induced allergic rhinitis. *Bioscience Reports*, 42(3), BSR20212681.
- Fang, H., Min, D., & Zhang, H. (2024). Paeoniflorin inhibits IL-13-induced oxidative stress and autophagy in BEAS-2B cells via STAT3. *Chinese Journal of Hospital Pharmacy*, 44(13), 1535–1540.
- Fei, Z., & Ying, T. (2022). Astragaloside IV treats allergic rhinitis in mice by balancing Th17/Treg cells and related cytokines. *Journal of Shenyang Pharmaceutical University*, 39(3), 277–282.
- Fu, Q., & Zhang, Q. (2025). Interpretation of international guideline for clinical practice of Chinese medicine: Allergic rhinitis. *Journal of Sichuan University (Medical Sciences)*, 56(4), 1027.
- Gong, Z. (2018). Efficacy evaluation of intranasal acupuncture in the treatment of allergic rhinitis and exploration of its neuroimmunomodulatory mechanism [Master 's thesis, Beijing University of Chinese Medicine].
- Greiner, A. N., Hellings, P. W., Rotiroti, G., & Scadding, G. K. (2011). Allergic rhinitis. *The Lancet*, 378(9809), 2112–2122.
- Gu, J., Xu, X., Hou, J., Wang, B., & Liu, Y. (2025). Research progress on the mechanism of traditional Chinese medicine in the treatment of allergic rhinitis. *Modern Journal of Integrated Traditional Chinese and Western Medicine*, 34(17), 2450–2457.
- Guo, L., Cong, P., Shen, Q., Xiong, G., & Ge, Y. (2014). Mechanism of Xinhuang decoction on histamine-induced in vitro allergic rhinitis mucosal tissue. *Chinese Archives of Traditional Chinese Medicine*, 32(5), 1183–1185.
- He, X., Fan, H., Sun, M., Li, J., Xia, Q., Jiang, Y., & Liu, B. (2024). Structural analysis and immunomodulatory activity of a novel polysaccharide from *Saposhnikovia Radix*. *Chinese Traditional and Herbal Drugs*, 55(4), 1089–1099.
- He, X., Liu, L., Luo, X., Zhu, J., Yang, H., Wang, J., Chen, L., & Zhong, L. (2022). Astragalus polysaccharide relieves inflammatory responses in guinea pigs with allergic rhinitis via ameliorating NF- κ B-mediated Treg/Th17 imbalance. *American Journal of Rhinology & Allergy*, 36(5), 638–648.
- Hu, T., Dong, Y., Yang, C., Zhao, M., & He, Q. (2021). Pathogenesis of children 's allergic diseases: Refocusing the role of the gut microbiota. *Frontiers in Physiology*, 12, 749544.
- Huang, S., Li, S., Chen, Z., & Peng, T. (2018). Effect of tanshinone IIA on mast cell-mediated allergic rhinitis by regulating the NF- κ B pathway. *Medical Journal of Wuhan University*, 39(2), 223–227.

- Jia, M., Zhang, S., Yu, Y., Xiao, S., Xiong, Y., & Han, G. (2022). Effects of Lu'e Biyan formula on Treg/Th17 cells and related cytokines in rats with allergic rhinitis. *China Journal of Traditional Chinese Medicine and Pharmacy*, 37(4), 1933–1937.
- Jian, L., Xiao, C., He, Q., Li, H., Zhou, W., Xu, X., Wang, Y., & Zhu, H. (2017). Effects of honeysuckle extract on cytokine expression in mice with allergic rhinitis. *Acta Medicinæ Universitatis Scientiæ et Technologiæ Huazhong*, 46(3), 285–290.
- Jin, Y., Zhu, Z., Wu, L., & Xuan, L. (2018). Effect of acupoint application on TLR-NF- κ B signaling pathway in nasal mucosa tissue of allergic rhinitis model rats. *Journal of Traditional Chinese Medicine*, 59(12), 1054–1057.
- Jung, M. A., Song, H. K., Jo, K., Lee, A., Hwang, Y. H., Ji, K. Y., Jung, D. H., Cai, M., Lee, J. Y., & Pyun, B. J. (2023). *Gleditsia sinensis* Lam. aqueous extract attenuates nasal inflammation in allergic rhinitis by inhibiting MUC5AC production through suppression of the STAT3/STAT6 pathway. *Biomedicine & Pharmacotherapy*, 161, 114482.
- Kim, A. Y., Marduy, A., de Melo, P. S., Gianlorenco, A. C., Kim, C. K., Choi, H., Song, J. J., & Fregni, F. (2022). Safety of transcutaneous auricular vagus nerve stimulation (taVNS): A systematic review and meta-analysis. *Scientific Reports*, 12(1), 22055.
- Kim, H. I., Kim, J. K., Kim, J. Y., Han, M. J., & Kim, D. H. (2019). Fermented red ginseng and ginsenoside Rd alleviate ovalbumin-induced allergic rhinitis in mice by suppressing IgE, interleukin-4, and interleukin-5 expression. *Journal of Ginseng Research*, 43(4), 635–644.
- Kong, W., Han, D., Zhou, L., Xu, G., & Han, D. (2014). *Otorhinolaryngology-Head and Neck Surgery*. People's Medical Publishing House.
- Lee, D. Y., Li, Q. Y., Liu, J., & Efferth, T. (2021). Traditional Chinese herbal medicine at the forefront battle against COVID-19: Clinical experience and scientific basis. *Phytomedicine*, 80, 153337.
- Li, H., Wang, Y., & Han, X. (2023). ESP-B4 promotes nasal epithelial cell-derived extracellular vesicles containing miR-146a-5p to modulate Smad3/GATA-3 thus relieving allergic rhinitis. *Phytomedicine*, 108, 154516.
- Li, Q., & Wei, Q. (2015). Clinical practice guideline for allergic rhinitis: Recommendations from the American Academy of Otolaryngology-Head and Neck Surgery. *Chinese Journal of Otorhinolaryngology Head and Neck Surgery*, 22(9), 482–486.
- Li, S., Xu, D., Wang, Y., & Gao, F. (2024). Research progress on regulation of programmed cell death by traditional Chinese medicine in treatment of allergic rhinitis. *Shanghai Journal of Traditional Chinese Medicine*, 58(12), 189–194.
- Li, Y., & Lu, Z. (2024). Study on the role of ephedrine in regulating Th2-type immune response by mediating TSLP/OX40L signaling pathway in rats with allergic rhinitis. *Drugs & Clinic*, 39(1), 14–22.
- Li, Y., Liu, X., Zhou, J., Li, F., Wang, Y., & Liu, Q. (2025). Artificial intelligence in traditional Chinese medicine: Advances in multi-metabolite multi-target interaction modeling. *Frontiers in Pharmacology*, 16, 1541509.
- Li, Y., Sun, L., & Zhang, Y. (2022). Programmed cell death in the epithelial cells of the nasal mucosa in allergic rhinitis. *International Immunopharmacology*, 112, 109252.

- Li, Z., Jing, W., Wang, Y., Li, T., Chang, Y., & Wang, Y. (2025). Effect of Cang'er Wendan decoction on the TLR4/MyD88/NF- κ B signaling pathway in rats with allergic rhinitis. *Guiding Journal of Traditional Chinese Medicine and Pharmacy*, 31(6), 36–41.
- Ma, C., Li, S., Hao, R., & Yang, L. (2019). Research progress and mechanism of traditional Chinese medicine in the treatment of allergic rhinitis. *Journal of Basic Chinese Medicine*, 25(10), 1473–1476.
- Mao, Y., Liu, K., Jiang, W., Hu, N., Yu, J., Zhang, Y., & Zheng, J. (2021). Experimental study on the effect of Chuanxiong Baizhi on hemorheology and expression of inflammatory factors in allergic dermatitis model. *Progress in Modern Biomedicine*, 263.
- Meihui, T., Yanan, Z., Weifang, S., Huan, L., & Yong, T. (2024). Mechanism of acupuncture at "sphenopalatine point" in improving immune inflammatory response in rats with allergic rhinitis based on TLR4/MyD88/NF- κ B signaling pathway. *Acupuncture Research*, 49(5), 456–462.
- Niu, M., Wu, H., Wang, Y., Li, R., Zhang, Y., Xu, Z., Qin, Y., Liu, H., Han, J., & Dong, S. (2025). Macrophage polarization and allergic rhinitis: A review. *International Immunopharmacology*, 164, 115334.
- Nunez, H., Nieto, P. A., Mars, R. A., Ghavami, M., Sew Hoy, C., & Sukhum, K. (2025). Early life gut microbiome and its impact on childhood health and chronic conditions. *Gut Microbes*, 17(1), 2463567.
- Nur Husna, S. M., Tan, H. T. T., Md Shukri, N., Mohd Ashari, N. S., & Wong, K. K. (2021). Nasal epithelial barrier integrity and tight junction disruption in allergic rhinitis: Overview and pathogenic insights. *Frontiers in Immunology*, 12, 663626.
- Ren, J., Han, Y., Zhang, Z., Ren, A., Chen, Y., & Li, X. (2023). Study on the effects of Saposhnikovia polysaccharides on ethology, AQP5 and nasal mucosa tissue in allergic rhinitis rats based on NF- κ B/STAT3 signaling pathway. *Medical Journal of West China*, 35(1), 39–45.
- Salem, I., Ramser, A., Isham, N., & Ghannoum, M. A. (2018). The gut microbiome as a major regulator of the gut–skin axis. *Frontiers in Microbiology*, 9, 382698.
- Seijo-Martinez, M., Varela-Freijanes, A., Grandes, J., & Vazquez, F. (2006). Sneeze-related area in the medulla: Localisation of the human sneezing centre? *Journal of Neurology, Neurosurgery & Psychiatry*, 77(4), 559–561.
- Shao, L., & Zhang, B. (2013). Traditional Chinese medicine network pharmacology: Theory, methodology and application. *Chinese Journal of Natural Medicines*, 11(2), 110–120.
- Shi, X., Gu, X., & Fu, X. (2024). Anti-inflammatory mechanism of Bimin formula in the treatment of allergic rhinitis based on Th17/IL-17A signaling pathway. *Journal of Chinese Medicinal Materials*, 47(4), 1016–1019.
- Sun, S., Gu, X., Qian, P., Yu, X., Zheng, J., Zhao, Q., Li, J., & Hong, M. (2023). Systematic pharmacology-based exploration of the targets and mechanisms of Sanfeng Tongqiao dripping pills in the treatment of allergic rhinitis. *Journal of Nanjing University of Traditional Chinese Medicine*, 39(10), 999–1005.

- Tian, M., Zhang, Y., Sun, W., Liu, H., & Tang, Y. (2024). Mechanism of acupuncture at “sphenopalatine point” in improving immune inflammatory response in rats with allergic rhinitis based on TLR4/MyD88/NF- κ B signaling pathway. *Acupuncture Research*, 49(5), 456–462.
- Tong, W., & Yan, L. (2025). Research progress in the treatment of allergic rhinitis with traditional Chinese medicine. *Traditional Chinese Medicine*, 14, 2211.
- Wang, J., Feng, X., Li, T., Bi, Y., Zhang, T., Xu, H., Yu, G., Zhang, C., & Sun, Y. (2022). Preliminary study on potential compounds and mechanism of Chuanxiong Chatiao granules in treating migraine. *Pharmacological Research – Modern Chinese Medicine*, 4, 100134.
- Wang, L., Fu, H., & Zhou, Z. (1999). Effect of Asarum and Fructus Xanthii on interferon induction in mice. *Chinese Journal of Clinical Pharmacy, Suppl.*, 23–25.
- Wang, M., Fu, L., Wang, H., & Tian, L. (2025). Hotspots and trends in allergic rhinitis nasal mucosa studies: A bibliometric analysis (2010–2024). *Journal of Asthma and Allergy*, 417–435.
- Wang, N., Du, N., Peng, Y., Yang, K., Shu, Z., Chang, K., Wu, D., Yu, J., Jia, C., & Zhou, Y. (2021). Network patterns of herbal combinations in traditional Chinese clinical prescriptions. *Frontiers in Pharmacology*, 11, 590824.
- Wang, R., Wang, Y., Yang, Q., Liu, J., Lu, Z., Xu, W., Zhu, J., Liu, H., He, W., & Yan, Y. (2024). Xiaoqinglong decoction improves allergic rhinitis by inhibiting NLRP3-mediated pyroptosis in BALB/C mice. *Journal of Ethnopharmacology*, 321, 117490.
- Wang, S., Fu, Z., & Wu, X. (2024). Effect of Lycium barbarum polysaccharides on Th1/Th2 cytokines in mice with allergic rhinitis based on NF- κ B signaling pathway. *Modern Journal of Integrated Traditional Chinese and Western Medicine*, 33(7), 928–932.
- Wang, X., Liu, J., Tian, Q., Guo, W., Li, Y., Liu, C., Yang, C., & Ma, C. (2016). Research progress on the immunomodulatory effect of paeoniflorin on cellular immunity. *Chinese Archives of Traditional Chinese Medicine*, 34(6), 1306–1308.
- Wang, X., Wu, M., Lai, X., Zheng, J., Hu, M., Li, Y., & Li, S. (2020). Network pharmacology to uncover the biological basis of spleen qi deficiency syndrome and herbal treatment. *Oxidative Medicine and Cellular Longevity*, 2020, 2974268.
- Wang, Y., Yang, H., Chen, L., Jafari, M., & Tang, J. (2021). Network-based modeling of herb combinations in traditional Chinese medicine. *Briefings in Bioinformatics*, 22(5), bbab106.
- Wang, Z., Liu, S., Li, S., Wei, F., Lu, X., Zhao, P., Sun, C., & Yao, J. (2025). Jingfang granules alleviate OVA-induced allergic rhinitis through regulating endoplasmic reticulum stress signaling pathway. *Journal of Ethnopharmacology*, 338, 119039.
- Wei, X., Ding, M., Liang, X., Zhang, B., Tan, X., & Zheng, Z. (2023). Mahuang Fuzi Xixin decoction ameliorates allergic rhinitis and repairs the airway epithelial barrier by modulating lung microbiota dysbiosis. *Frontiers in Microbiology*, 14, 1206454.
- Wu, J., Zhang, B., Zhang, Y., & Zhang, H. (2020). Potential biological mechanism and preliminary validation of Majie formula against allergic rhinitis based on network pharmacology. *Journal of Beijing University of Traditional Chinese Medicine*, 43(8), 12-19.

- Wu, L., Liu, Y., & Wang, C. (2023). Clinical progress in the treatment of allergic rhinitis. *Advances in Clinical Medicine*, 13, 16256.
- Xi, Y., He, X., & Liu, Y. (2023). Protective effect and mechanism of modified Yupingfeng nasal spray on nasal mucosal injury in AR model rats. *China Pharmacy*, 34(10), 1204–1210.
- Xiao, Z., & Xu, J. (2025). Research progress on the mechanism of action of intranasal acupuncture in the treatment of allergic rhinitis. *Guangming Journal of Chinese Medicine*, 40(18), 4078–4081.
- Xiao, Z., Deng, Q., Zhou, W., & Zhang, Y. (2022). Immune activities of polysaccharides isolated from *Lycium barbarum* L.: What do we know so far? *Pharmacology & Therapeutics*, 229, 107921.
- Xie, W., Chen, H. G., Chen, R. H., Zhao, C., Gong, X. J., & Zhou, X. (2024). Intervention effect of *Lycium barbarum* polysaccharide on lead-induced kidney injury mice and its mechanism based on PI3K/Akt/mTOR signaling pathway. *Journal of Ethnopharmacology*, 319, 117197.
- Xu, N., Hua, Y., Tan, X., Wang, J., Liang, Z., Zhou, S., Li, Y., Chen, W., Xia, J., & Luo, Q. (2024). Effects of Bimin formula on TMEM16A/NF- κ B/MUC5AC signaling pathway in nasal mucosa of allergic rhinitis model rats with lung-spleen qi deficiency syndrome. *Journal of Traditional Chinese Medicine*, 65(8), 842–848.
- Yan, D. (2021). Yan Daonan's effective prescriptions and clinical experience — Yiqi Wenyang formula. *Jiangsu Journal of Traditional Chinese Medicine*, 53(8), 5–6.
- Yan, J., Zhang, S., Xiao, S., Fan, J., Luo, X., & Jia, M. (2024). Effects of Lu'e Biyan formula on Th17/Treg in allergic rhinitis mice based on Notch1–Jagged1 signaling pathway. *Chinese Journal of Integrated Traditional and Western Medicine*, 44(5), 575–582.
- Yan, Z., Jiao, L., Gong, Z., Liu, L., Liu, S., Liu, Q., Li, X., Zhang, Y., Bian, F., & Liu, J. (2018). Clinical observation on 60 cases of moderate–severe allergic rhinitis treated with intranasal acupuncture combined with Yiqi Jiemin decoction. *Journal of Traditional Chinese Medicine*, 59(12), 1035–1038.
- Yang, M., Zhu, X., Fu, F., Guo, Q., Zhu, X., Xu, Y., Yan, X., He, X., & Wang, X. (2022). Baicalin ameliorates inflammatory response in a mouse model of rhinosinusitis via regulating the Treg/Th17 balance. *Ear, Nose & Throat Journal*, 101(2_suppl), 8S–16S.
- Yang, Q., Sun, Y., An, J., Wang, L., Zhang, C., Fei, Y., Wu, K., Zhai, X., & Wu, Y. (2025). Xiaoqinglong decoction attenuates inflammatory response and mitochondrial injury via the TLR4/MyD88/NF- κ B pathway in allergic rhinitis. *International Archives of Allergy and Immunology*, 186(10), 927–940.
- Yu, N., Huang, J., Liu, J., Wang, S., Zhang, Y., Wu, F., & Yu, G. (2025). Development of a cold–heat syndrome classification model for children with allergic rhinitis based on multimodal data. *Translational Pediatrics*, 14(12), 3375–3386.
- Yu, S., Qian, H., Tian, D., Yang, M., Li, D., Xu, H., Chen, J., Yang, J., Hao, X., & Liu, Z. (2023). Linggui Zhugan decoction activates the SIRT1-AMPK-PGC1 α signaling pathway to improve mitochondrial and oxidative damage in rats with chronic heart failure. *Frontiers in Pharmacology*, 14, 1074837.

- Zhang, F., & Tian, Y. (2022). Astragaloside IV treats allergic rhinitis in mice by balancing Th17/Treg cells and related cytokines. *Journal of Shenyang Pharmaceutical University*, 39(3), 277–282.
- Zhang, Y., Li, J., Zhao, Y., Wang, C., & Zhang, L. (2019). Identification of rare variants of allergic rhinitis based on whole genome sequencing and gene expression profiling. *World Allergy Organization Journal*, 12(6), 100038.
- Zhang, Y., Song, Y., Wang, C., Jiang, J., Liu, S., Bai, Q., Li, L., Jin, H., Jin, Y., & Yan, G. (2022). Panax notoginseng saponin R1 attenuates allergic rhinitis through AMPK/Drp1-mediated mitochondrial fission. *Biochemical Pharmacology*, 202, 115106.
- Zhang, Y., Wu, N., & Wang, W. (2015). Morphological observation of the effects of modified licorice and dried ginger decoction on pharyngolaryngeal mucosa in allergic rhinitis rat models. *Journal of Guizhou University of Traditional Chinese Medicine*, 37(3), 9–12.
- Zhou, Y., Peng, L., Zhang, Y., & Sun, X. (2024). Research progress on structural optimization and biological activities of triptolide. *Chinese Pharmaceutical Journal*, 59(19), 1795–1806.
- Zhou, Y., Wang, Y., Zhang, Q., Hou, X., Zhou, K., & Li, L. (2024). Acupoint injection inhibits abnormal mucin secretion and nasal mucosal inflammatory response in allergic rhinitis rats via the p38 MAPK pathway. *Acupuncture Research*, 49(11), 1160–1167.
- Zhu, H., Rong, P., Chen, Y., Song, X., & Wang, J. (2024). Possible mechanism of auricular point therapy for migraine via the auricular vagus nerve. *Acupuncture Research*, 49(4), 403–408.

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