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IMMUNOMODULATION IN AYURVEDA: A COMPREHENSIVE REVIEW

Dr. Rohit Mandal*[1], Dr. Roshika Singh[2]

[1]PG Scholar, Department of Swasthavritta, CBPACS, Delhi.

[2]PG Scholar, Department of Swasthavritta, KLE Shri BMK Ayurveda Mahavidyalaya, Belagavi, Karnataka.

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***Corresponding Author**

Dr. Rohit Mandal

PG Scholar, Department of Swasthavritta, CBPACS, Delhi.

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ABSTRACT

Background: The immune system involves a complex interplay of cellular and humoral components that protect the host against pathogens and maintain homeostasis. In Ayurveda, the concept of immunity is encapsulated in terms like *Vyadhikshamatva* (disease resistance) and *Ojas* (vital essence). As global health paradigms shift towards preventive medicine, the immunomodulatory potential of Ayurvedic herbs and formulations (*Rasayanas*) has garnered significant scientific interest. **Methods:** A systematic search was conducted using databases including PubMed, Scopus, Google Scholar, and the DHARA interface. Keywords included "Immunomodulation," "Ayurveda," "Rasayana," "Vyadhikshamatva," and specific medicinal plants. Classical texts (*Charaka Samhita*, *Sushruta Samhita*) were reviewed for theoretical frameworks. The study synthesises data on pharmacological mechanisms, in vitro/in vivo studies, and clinical applications. **Results:** Ayurvedic immunomodulation functions through three primary dimensions: *Rasayana* (rejuvenation), *Vyadhibala Virodhitvam* (attenuating disease progression), and *Vyadhikutpadaka Pratibandhakatvam* (preventing disease origin). Key herbs such as *Withania somnifera* (Ashwagandha), *Tinospora cordifolia* (Guduchi), and *Emblica officinalis* (Amalaki) demonstrate dual capabilities: immunostimulation against infections and immunosuppression in autoimmune conditions. Mechanisms include the modulation of cytokine expression (IL-2, IFN-γ, TNF-α), regulation of oxidative stress via antioxidant pathways, and influence on the gut microbiome

(Agni). Polyherbal formulations like Chyawanprash show synergistic effects on Natural Killer (NK) cell activity. **Conclusion:** Ayurvedic immunomodulators offer a holistic approach to host defence, distinct from the specific antigen-antibody focus of modern immunology. By stabilising the neuro-endocrine-immune axis, these interventions hold promise for integrative management of immunodeficiency, cancer, and autoimmune disorders. Further standardised clinical trials are essential to validate these mechanisms globally.

KEYWORDS: Ayurveda, Immunomodulation, Vyadhikshamatva, Rasayana, Ojas, Innate Immunity.

INTRODUCTION

The human immune system is a sophisticated biological network designed to distinguish 'self' from 'non-self,' thereby eliminating pathogens and removing malignant cells. Modern immunology has largely focused on specific pathways—vaccines for adaptive immunity, antibiotics for bacterial elimination, and immunosuppressants for autoimmunity. However, the rise of antibiotic resistance, the prevalence of chronic autoimmune disorders, and the recent global pandemic have necessitated a shift in focus from "killing the pathogen" to "strengthening the host.[1] This concept of host defence is the cornerstone of Ayurveda, the traditional system of medicine from India.

In Ayurveda, immunity is not merely the presence of antibodies but a holistic state of biological strength (*Bala*), resilience (*Vyadhikshamatva*), and metabolic equilibrium (*Agni*). The classical text *Charaka Samhita* defines *Vyadhikshamatva* as the ability of the body to fight existing diseases (*Vyadhibala Virodhitvam*) and prevent the manifestation of future diseases (*Vyadhikutpadaka Pratibandhakatvam*).[2] This aligns conceptually with the modern understanding of innate and adaptive immunity.

The biological substrate of immunity in Ayurveda is often correlated with *Ojas*. *Ojas* is described as the final essence of all seven bodily tissues (*Dhatus*). It represents the vital energy that governs stability, strength, and life itself. A depletion of *Ojas* (*Ojakshaya*) leads to susceptibility to infections and degenerative diseases, closely mirroring the concept of immunodeficiency.[3] To maintain or restore this immunity, Ayurveda employs a specialised branch of medicine known as *Rasayana Tantra*. *Rasayana* therapies are not simple nutritional supplements; they are specialised immunomodulators that improve the quality of tissues and microcirculation (*Srotas*). Unlike modern immunostimulants that may trigger a hyper-

immune response (cytokine storm), *Rasayana* drugs are often "adaptogenic"—they modulate the immune response, stimulating it when depressed and suppressing it when overactive (as in allergies or autoimmunity).[4]

This article aims to provide a comprehensive review of immunomodulation in Ayurveda. It utilises the IMRAD format to explore the theoretical foundations, review the pharmacological evidence of key herbs, analyse the biological mechanisms involved, and discuss the clinical relevance of integrating Ayurvedic immunomodulation into contemporary healthcare.

METHODS

Study Design and Data Sources

This article is structured as a narrative and systematic review. A comprehensive literature search was conducted to bridge the gap between classical Ayurvedic theory and modern immunopharmacology. The search strategy involved two distinct phases.

Classical Literature Review: Primary Ayurvedic texts, specifically the *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya*, were consulted to extract concepts related to *Ojas*, *Bala*, *Vyadhikshamatva*, and *Rasayana*.

Modern Scientific Literature Review: Electronic databases, including PubMed, Scopus, Web of Science, Google Scholar, and DHARA (Digital Helpline for Ayurveda Research Articles), were searched.

Review

❖ **Conceptual Framework of Immunity in Ayurveda**

The results indicate that immunity is dependent on three factors: *Agni* (Metabolic Fire), *Dhatu Sarata* (Tissue Excellence), and *Srotas* (Channels ensuring proper transport of nutrients).

❖ **Classification of Ayurvedic Immunomodulators**

Rasayanas are classified into three categories: *Kamya Rasayana* (general health), *Naimittika Rasayana* (disease-specific), and *Ajasrika Rasayana* (dietary intake).

❖ **Pharmacological Profile of Key Herbs**

➢ **Withania somnifera (Ashwagandha)**

- **Mechanism:** Acts as a potent adaptogen, increasing WBC and platelet counts.

- **Results:** In immunosuppression models, it significantly restored bone marrow cellularity. It modulates the Th1/Th2 cytokine balance and reduces experimental immune inflammation.[5],[6]

➢ **Tinospora cordifolia (Guduchi)**

- **Mechanism:** Enhances the killing ability of macrophages and neutrophils and increases nitric oxide production.
- **Results:** Activates the NF-κB pathway and exhibits efficacy in allergic rhinitis and autoimmune disease models.[7],[8]

➢ **Emblica officinalis (Amalaki)**

- **Mechanism:** Works through antioxidant pathways, protecting immune cells from oxidative damage.
- **Results:** Counteracts arsenic-induced oxidative stress and promotes the proliferation of splenocytes.[9]

➢ **Ocimum sanctum (Tulsi)**

- **Mechanism:** Modulates both humoral and cell-mediated immunity.
- **Results:** Increases antibody titers and inhibits histamine release, providing benefits in respiratory infections.[10]

➢ **Piper longum (Pippali)**

- **Mechanism:** Acts as a bioenhancer (*Yogavahi*).
- **Results:** Increases the absorption of curcumin and other phytochemicals, amplifying the immune response.[11]

➢ **Polyherbal Formulations**

- **Chyawanprash:** Clinical trials indicate it reduces the frequency of upper respiratory tract infections and enhances macrophage function.[12]
- **Ayush-64:** Used extensively during the COVID-19 pandemic; results showed faster clinical recovery and reduced inflammation markers.[13]

❖ **Mechanisms of Action Synthesis**

The review identifies four primary pathways: Toll-Like Receptor (TLR) Signalling, Cytokine Regulation, Antioxidant Defence, and the Neuro-Endocrine-Immune Axis.

❖ DISCUSSION

The Interface of Ojas and Modern Immunology

The correlation between *Ojas* and the immune system suggests that *Ojas* depletion matches the clinical presentation of immunodeficiency. The preservation of *Ojas* through *Rasayana* ensures that immune effector cells have the metabolic energy to function.[14]

Adaptogenic vs. Immunostimulant

Unlike simple stimulants, *Rasayanas* like Ashwagandha are amphoteric; they can downregulate inflammation in autoimmunity by suppressing NF-κB activation.[15] This "intelligence" is attributed to *Samyoga* (herbal synergy).

The Gut-Immune Connection (Agni)

Modern science confirms that GALT houses 70% of immune cells. Ayurvedic focus on *Agni* parallels the modern understanding of the microbiome's role in training the immune system.[16]

❖ Clinical Applications and Relevance

- **Cancer Adjunct Therapy:** *Rasayanas* protect bone marrow and reduce the side effects of cytotoxic drugs.
- **Geriatrics:** *Rasayana* is specifically indicated for *Jara* (ageing) to combat immunosenescence.[17]
- **Infectious Diseases:** Prophylactic use has shown reduced incidence of influenza-like illnesses.

❖ Conflict of Interest

Not any.

❖ CONCLUSION

Immunomodulation in Ayurveda involves a fundamental rebalancing of the body's metabolic functions (*Agni* and *Ojas*). Evidence demonstrates that herbs like *Withania somnifera*, *Tinospora cordifolia*, and *Emblica officinalis* possess potent properties mediated through cytokine regulation and stress reduction. The integration of Ayurvedic *Rasayanas* into public health protocols offers a holistic method for enhancing population immunity.[18]

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