Journal for Re Attach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 February; 6 (1): 2520-2533

Clinical and Experimental Insights into the Therapeutic Applications of Ayurvedic Formulations: A Review

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Abstract

Ayurveda is one of the ancient systems of traditional medicine that gained its reputation in the treatment of disease because it offered a comprehensive system of healthcare. The focus on Ayurvedic formulations has come back with a bang since it exhibits a therapeutic potential in the treatment of various chronic and lifestyle diseases. This review analyses both clinical and experimental studies on Ayurvedic formulations by studying their effectiveness in managing the disease alongside the pharmacological mechanism. The primary therapeutic applications considered in this review are metabolic disorders, along with neurological diseases, cardiovascular diseases, immunomodulation therapy, cancer treatment, and gastrointestinal health and dermatology treatment. The scientific review examines the pharmacologic effects of Ashwagandha, Curcumin, Giloy, Triphala, Arjuna, and Withaferin A, used to demonstrate their anti-inflammatory, antioxidant, neuroprotective, and immunomodulatory properties. Experimental studies revealed the medicinal processes that support the medical findings in the management of diabetes, together with the treatment of neurodegenerative, cardiovascular disorders, and infectious diseases. Meanwhile, clinical trials recorded successful results in these cases. The use of Ayurvedic therapies in modern medicine has been facing adoption barriers due to issues related to implementation standards, regulatory limitations, and the need to conduct extensive clinical research. Future research must integrate Ayurvedic practices with advanced medical technologies to improve their acceptance and naturally align them with evidence-based healthcare. The review demonstrates the necessity for interdisciplinary research to establish a connection between ancient knowledge and contemporary scientific evidence to validate Ayurveda as a valuable complementary medical practice.

Keywords: Ayurveda, traditional medicine, herbal formulations, clinical studies, experimental research, immunomodulation, metabolic disorders, cancer therapy.

Introduction

Through the span of 3000 years, Ayurveda emerged as a traditional medical system in India, which people call "the science of life." The complete health approach of Ayurveda has transformed the lives of millions of people who live in India, along with other countries across the globe. This traditional medical system uses the equilibrium between mind, body, and spirit to achieve wellness and stop illnesses from developing. The growing interest in Ayurvedic formulations during recent decades has driven scientists to validate these traditional medicines for modern healthcare integration (Sikder, 2024).

Historical Background and Evolution of Ayurveda in Healthcare

Integrative medical knowledge known as Ayurveda emerged during the Vedic period and its essential teachings appeared in medical texts such as the *Charaka Samhita* and *Sushruta Samhita*. The ancient medical works provided complete explanations about medical practices while offering extensive knowledge of healthcare. Throughout many centuries, Ayurveda developed by integrating various regional medical practices and knowledge traditions into its expanded therapeutic approaches (Narayanaswamy, 1981)

The medieval era brought difficulties to Ayurveda because of foreign invasions as well as the adoption of alternative medical systems. The medical system endured through adaptation by adopting beneficial elements from other medical systems into its existing practices. Western medicine gained dominance during the colonial period as one of the major obstacles faced by Ayurveda. Rural practitioners continued practicing Ayurveda, so traditional medical methods and ancient wisdom remained preserved.

Modern society has witnessed a revival of Ayurveda as it gains growing acceptance within national healthcare systems. The Indian government recognizes Ayurveda as an official medical discipline through its establishment of multiple Ayurvedic hospitals, along with clinics and educational institutions spread across the country. The global wellness industry has expanded through the widespread popularity of Ayurvedic products that include herbal supplements and skincare items, and wellness therapies. Modern healthcare systems have benefited from Ayurvedic integration through the development of new clinical research and studies that evaluate Ayurvedic treatment effectiveness (Sikder, 2024).

Importance of Scientific Validation of Ayurvedic Formulations

In the contemporary era, the integration of traditional medicine into mainstream healthcare necessitates rigorous scientific validation. This necessitates standardization of Ayurvedic formulations, which include several herbal and mineral ingredients to ensure their safety and quality and to ensure effective performance. The scientific process of validating Ayurvedic medication consists of pharmacological research along with clinical trials and standard manufacturing processes. These measures will enhance Ayurvedic credibility and make it more acceptable globally (Lakhotia, 2019).

The Central Council Research in Ayurvedic Sciences (CCRAS) is an essential organization that carries out studies to validate conventional Ayurvedic formulations. The research studies aim to determine both data on clinical safety and efficacy, which will resolve questions about the scientific basis of traditional remedies. CCRAS and other organizations utilize peer-reviewed journal publications to develop medical knowledge and incorporate Ayurvedic practices into evidence-based medicine (Khanduri et al., 2018).

The standardization of Ayurvedic formulations continues to be hampered by the fact that herbal mixtures are complicated, and varying production methods are employed. Standardization of Ayurvedic products should be a collective effort between the traditional practitioners and the modern scientists, who should develop standardized guidelines in order to attain consistent quality standards.

Growing Global Interest in Ayurveda-Based Therapeutics

The worldwide wellness industry shows increasing interest in natural health solutions, which makes Ayurveda its central focus. The combination of chronic disease growth and public understanding about synthetic drug side effects and individualized medical care preferences drives this trend. The treatment methods of Ayurveda match current healthcare trends because they focus on developing specific therapies for individual patients.

Various nations across the world identify Ayurveda as a powerful tool for advancing health and wellness practices. The Indian government supports Ayurveda through its Ayush visa program, which targets wellness tourism as part of its promotion strategy. Modern healthcare providers now work together with Ayurvedic practitioners to merge Ayurvedic principles into conventional medical practices (Hazari, 2023).

Modern healthcare systems accept Ayurvedic integration, which has resulted in new research and clinical studies that validate Ayurvedic treatment effectiveness. The increasing number of validated studies about Ayurveda helps establish its acceptance across global healthcare settings. The analysis of this research examines experimental and clinical evidence that demonstrates therapeutic uses of Ayurvedic formulations using an analytical approach. The review evaluates traditional knowledge integration into modern healthcare through historical perspectives and scientific validation processes, as well as worldwide Ayurveda resurgence. The analysis includes reviewing recent studies while highlighting missing scientific data and suggesting future research for strengthening Ayurvedic therapeutic acceptance in modern medical practices (Gupta, 2024).

Ayurvedic Principles and Therapeutic Mechanisms

Among the core principles of Ayurvedic medicine stands the vital understanding of the three vital energies, the Doshas, which are Vata, Pitta, and Kapha. The three bio-energetic forces known as Doshas originate from the fundamental elements, which include space (ether), air, fire, water, and earth. The Doshas contain distinct elemental combinations that control particular body functions both physically and mentally. The health condition and disease risk of individuals depend on the state of balance between their Doshas according to Ayurvedic beliefs (Verma et al., 2024).

Vata Dosha is made up of space and air. Vata is the moving energy that regulates all body processes, such as blood circulation and breathing, as well as the transmission of nerve signals. Individuals whose Vata is the predominant Dosha are usually skinny with dry skin as their physical characteristics. Individuals who are Vata dominant are quick in learning and are creative, but they can also become anxious and restless when experiencing an imbalance of Vata. The imbalance of vata results in three primary health issues, namely: joint pain, constipation, and neurological disorders. Individuals experiencing Vata imbalance need to adhere to routine and consume warm, nutritious food, and engage in relaxing exercises like yoga and meditation (Shinde, 2024).

Pitta Dosha, which is transformational energy, is the combination of the fire and water elements. This dosha is used by the body to regulate metabolic activities that influence digestion, body temperatures, and hormone regulation. Individuals whose Pitta is dominant have an average body composition and warm body temperature and exhibit the qualities of smart thinking and leadership skills. Pitta Dosha imbalance causes irritability and leads to inflammation and generates digestive disorders such as acid reflux and ulcers. According to Ayurvedic principles, Pitta balance requires the consumption of cooling foods and stress reduction practices, and the elimination of spicy and hot foods (Agrawal & Gehlot, 2018).

Kapha Dosha unites earth and water elements to create a body energy that provides structure and lubrication. The body receives its physical structure and stability from this energy while also gaining strength, and the immune system operates under its control, and tissue development occurs. People with Kapha constitution exhibit strong physical frames and peaceful personalities, together with soft skin. The balanced state of Kapha drives human beings to

experience love along with mental stability and forgiveness. An excessive amount of Kapha Dosha leads to weight gain, as well as respiratory congestion and physical sluggishness. The Ayurvedic approach to Kapha balance includes physical stimulation and eating various light and warm foods together with regular exercise (Chaugan, 2024).

According to Ayurvedic principles, health occurs when all three Doshas maintain equilibrium with each other. The equilibrium between these forces remains stable until any type of imbalance emerges, which develops into medical conditions. An aggravated Vata can trigger insomnia and dry skin, whereas elevated Pitta leads to inflammatory conditions, and Kapha excess causes obesity alongside sinus congestion. Dietary and lifestyle decisions, along with treatment interventions in Ayurveda, follow personalized approaches because they need complete knowledge of each person's Prakriti (Dosha composition) according to Telles et al. (2015).

During disease management, Ayurvedic practitioners evaluate the present Dosha condition (Vikriti) to determine which Doshas are out of balance. The treatment approach is developed specifically to calm the Dosha(s) that have become unbalanced. An individual with Vata imbalance would receive treatment recommendations including ground-based activities alongside warm and moist food choices and relaxation exercises. Individuals with Pitta imbalance will be relieved when they eat cooling foods and are in relaxing settings, and undergo stress-reducing strategies. Kapha imbalances require individuals to adopt stimulating activities and consume a light diet, but they should engage in invigorating exercises. The individualized therapies in Ayurveda prove the preventive quality of Ayurveda since they operate to maintain the balance of Doshas (Shrivastava et al., 2020).

The concept of diseases in terms of Doshas is a major branch of Ayurvedic medicine. Ayurveda states that diseases have a six-stage process beginning with an imbalance of Dosha. Early symptoms of Dosha imbalances can allow medical specialists to take the necessary measures, which may prevent the development of diseases to their full extent. The preventive nature of Ayurvedic practice requires regular health assessments combined with personalized care according to Patil and Sapra (2013).

The Dosha framework enables practitioners to understand mental health conditions. The three Doshas manifest as anxiety and fear for Vata, while Pitta results in anger and irritability, and Kapha expresses itself through depression and attachment. Rasayana therapy allows Ayurvedic practitioners to understand mental-emotional disorders better so they can suggest suitable personalized interventions that include behavioral adjustments, dietary advice, and herbal treatments.

Role of Rasayana (rejuvenation therapy) in health and longevity

Rasayana, a fundamental branch of Ayurveda, focuses on rejuvenation and the promotion of health and longevity. The Sanskrit term Rasayana combines "Rasa", meaning essential body fluid, with "Ayana", meaning path, which together describe the path of nourishment. Rasayana therapy works to improve Rasa quality, which enables tissue revitalization while boosting immunity and postponing the aging process (Shailesh & Vinayak, 2018).

The main function of Rasayana therapy involves both enhancing lifespan and reducing age-related deterioration of the body. Rasayana treatment methods nourish the body tissues while boosting their healing potential to achieve a longer lifespan and become more youthful. According to Ayurveda, the focus goes beyond life extension to include the improvement of life quality, which allows people to stay healthy and vital throughout their aging years (Chulet & Pradhan, 2009).

Rasayana demonstrates significant ability to modify immune system functions. The defense mechanisms grow stronger through Rasayana therapies, which lead to better disease resistance and improve total life expectancies. The improved immune system functions enable the body to fight off pathogens while making illness recovery quicker and more efficient. Rasayana treatment benefits the mental state through its ability to improve memory function, together with cognitive abilities and emotional stability maintenance. The mind-nourishing properties of Rasayana therapy help develop mental abilities while creating a balanced state of being, which promotes complete well-being and long life (Singh et al., 2021). Modern researchers have shown renewed interest in Rasayana therapy as they conduct multiple investigations to understand its modern-day benefits. Research investigations have examined how Rasayana herbs function as antioxidants, along with their capability to improve immunity and their ability to boost human lifespan duration. Modern research has established scientific evidence for the traditional beliefs connected to Rasayana practice, thus demonstrating a connection between traditional knowledge and contemporary scientific methods.

Synergistic effects of polyherbal formulations

For numerous centuries, polyherbalism has remained central to Ayurvedic medicine because practitioners combine multiple herbs into single therapeutic preparations. Scientists have adopted this methodology because they think plant components synergize to create greater medical benefits while reducing side effects when treating multiple disorders better than single-harbor treatments. The intertwining effects of multiple herbs in polyherbal formulations produce stronger outcomes than what would be possible with single herbs alone, which results in better health benefits according to Karole et al. (2019).

Multiple processes enable the synergistic actions that occur between different ingredients found in polyherbal formulations. The combined actions of various phytochemicals contained in the different herbs create a main

mechanism for polyherbal formulations. The compounds found in specific herbs act to boost the availability of active components in other herbs, thus strengthening their therapeutic strength. The therapeutic profile of polyherbal formulations becomes safer and more balanced because certain herbs contain properties that neutralize possible adverse effects of other formulation components (Rajini & Muralidhara, 2023).

The traditional Ayurvedic combination Triphala stands as a polyherbal formulation that unites three fruits, Amalaki (*Emblica officinalis*), Bibhitaki (*Terminalia bellirica*), and Haritaki (*Terminalia chebula*). Digestive health improvement, together with detoxification and rejuvenation, occurs through additive effects between linked therapeutic agents found in each Herbal compound. The traditional medical use of Triphala receives scientific backing through research showing its antioxidant properties and anti-inflammatory effects, and antimicrobial activities (Ahmed et al., 2021).

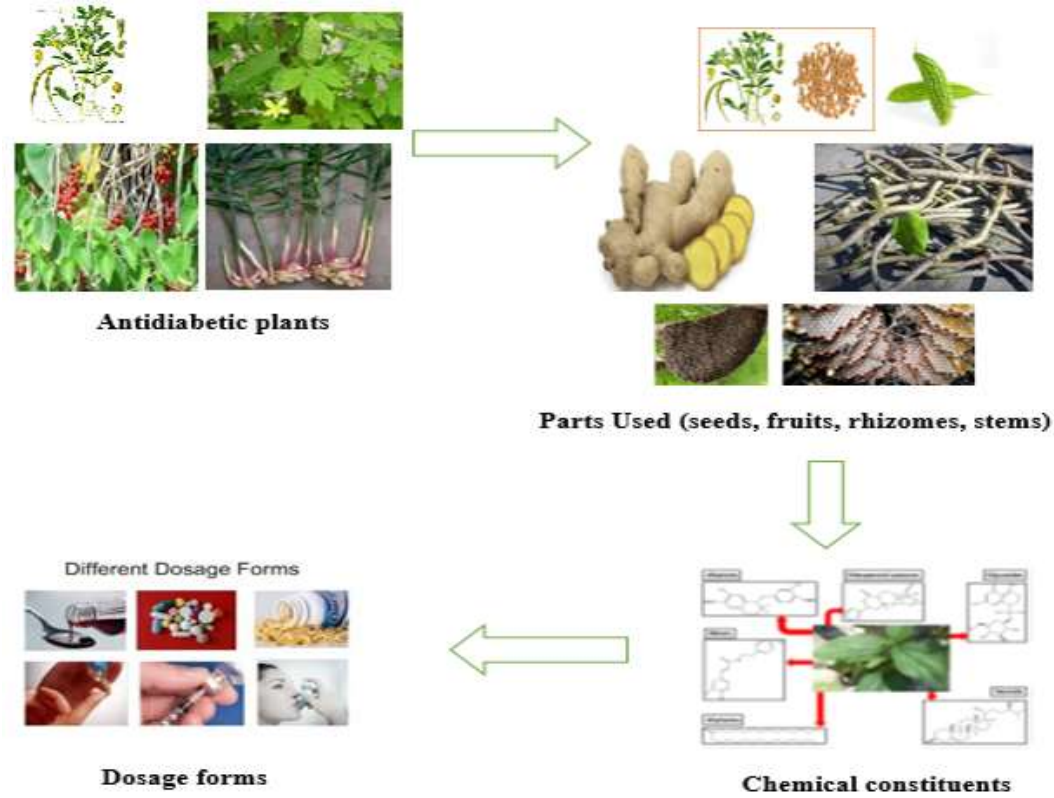

Figure 1: Polyherbal formulation concept (Kher & Patel et al., 2023).

Ayurvedic pharmacodynamics in comparison with modern medicine

Modern pharmacodynamic studies show identical and different effects when analyzing Ayurvedic polyherbal formulations relative to Western medical methods. Pharmacological medications in contemporary science are developed to target particular receptor mechanisms for producing defined medical outcomes. Scientists achieved the development of precise medicines for different diseases through reductionist medical approaches. The precise nature of these drugs sometimes produces unwanted consequences because they disturb other natural body functions (Ebadi, 2006).

Multiple herbal ingredients in Ayurvedic medicines function under a body-mind unified perspective by working to maintain balance throughout all systems. These multi-targeted ayurvedic formulations can modify several physiological pathways at once, thus benefiting people with multiple-factor diseases like metabolic disorders, chronic inflammations, and neurological diseases. The approach uses biological systems to understand health and disease relationships in line with contemporary scientific models of systems biology (Aggarwal et al., 2006).

The application of Ayurvedic polyherbal medications in contemporary medical use faces developmental hurdles because of problems regarding standardization, together with quality management systems and scientific validation demands. The complicated nature of polyhedral formulations hinders scientists from pinpointing which therapeutic components are active, thus making standardization procedures more challenging. The inconsistent methods used during medicinal plant cultivation and harvesting, and processing steps result in variable potency and effectiveness in the final product (Katiyar & Dubey, 2023).

Modern analytical methods gain increasing importance in determining polyherbal formulation phytochemical components, while clinical trials play a crucial role in confirming safety and efficacy. Complex mixture research combined with modern pharmacokinetic and pharmacodynamic studies provides insights regarding absorption and

distribution, metabolism, and excretion of these mixtures that can be used to explain their therapeutic effects (Verma et al., 2024).

Table 1: Represents the comparison of modern medicines and traditional medicines

Modern Medicine	**Traditional medicines**
Suppresses only the symptoms of the disease	Targets the root cause of disease
Prolonged use has side effects.	It is natural and, hence, gentle on the body.
Drugs are costly	Treatments are cost-effective
Resistance to antibiotics is causing treatment failure	It is effective against pathogens that show resistance to allopathic drugs
Treatment is mainly through oral medication.	Treatment is holistic; it includes oral medicines, therapies, diet, and exercise.

Review of Literature: Clinical and Experimental Insights

Through the years, Ayurveda has now known worldwide due to its entire system of healing that takes care of health and diseases in a holistic manner. The Ayurvedic therapeutic tools comprise various formulations that are based on medicinal plants and minerals, among other natural materials. Multiple clinical and experimental studies that have been conducted to evaluate the effectiveness and safety of Ayurvedic formulations have to date produced substantial information about their applications in therapeutic purposes. A specific instance is systematic clinical assessments of the interventions employed to determine their potential in therapy. Regulation and registration of Ayurveda and traditional systems of medicine are based on pre-clinical and clinical trials that determine appropriate evaluation methodologies. The standardized testing procedures enable Ayurvedic formulations to be subjected to full safety and efficacy testing (Chauhan et al., 2022).

Ayurvedic Formulations for Metabolic and Lifestyle Disorders

Diabetes mellitus, along with obesity and metabolic syndrome, has emerged as a worldwide health issue that has prompted the medical fraternity to reconsider the traditional medical systems, such as Ayurveda, to explore potential therapeutic possibilities. As an ancient Indian medical system, Ayurveda treats health by combining the balance of Doshas (which record the three humors, Vata, Pitta, and Kapha) with maintaining digestive Agni as methods for disease control and prevention. Research demonstrates that Ayurvedic treatments show promise for metabolic disorders through both experimental trials and clinical applications, according to Deshmukh and Khemchandani (2023).

Diabetes, obesity, and metabolic syndrome

Madhumeha, which represents type 2 diabetes, appears in Ayurvedic literature under the Prameha category that includes various urinary disorders with excessive urination and turbidity. The development of Madhumeha results from Kapha and Vata Dosha imbalances, which disrupt metabolism while producing body impurities (Ama). Ayurvedic management strategies include modifying foods and lifestyles and administering herbal remedies that work to balance Doshas and activate biochemical processes according to Raut et al. (2024).

Ayurvedic medicine uses several traditional herbs as antidiabetic agents. The hypoglycemic effects of antidiabetic herbs include *Momordica charantia* (bitter melon) and *Trigonella foenum-graecum* (fenugreek), and *Gymnema sylvestre*. Various experimental studies prove these herbs function to control blood sugar through their impact on carbohydrate processing and insulin sensitivity, and their antioxidant properties. The antidiabetic evaluation of *Niruryadi Gulika* Ayurvedic formulation demonstrated its ability to reduce fasting blood glucose levels and enhance lipid profile performance in diabetic rats according to Panda et al. (2023).

Obesity or Sthaulya and Medoroga stands as a lipid metabolism disorder according to Ayurvedic medicine because Kapha Dosha imbalance and Mandagni create digestive fire impairment. Ayurvedic care for obesity implements dietary control programs coupled with exercise activities and herbal prescriptions, which work to optimize metabolic functions and decrease body fat accumulation. Traditional Ayurvedic medicine utilizes three herbs, namely *Commiphora mukul* (guggul), *Terminalia chebula* (haritaki), and *Zingiber officinale* (ginger), because of their lipid-lowering and thermogenic properties. Laboratory trials show that herbal therapies help obese patients lose weight while improving their blood lipids and lowering their Body Mass Index. Research has demonstrated that Ayurvedic formulation administration reduced body weight and total cholesterol and triglyceride levels in obese patients, thus demonstrating their effectiveness in obesity treatment (Gujarathi & Gujarathi, 2013).

Ayurvedic medicine identifies metabolic syndrome as Santarpanajanya Vikaras (diseases due to over-nutrition), which includes central obesity, hypertension, dyslipidemia, and insulin resistance as its components. Among Ayurvedic treatments for metabolic syndrome patients, detoxification through Panchakarma therapies, together with special dietary recommendations, lifestyle modifications, and herbal medications to restore metabolic stability. A review evaluated the Ayurvedic treatment of metabolic syndrome, which showed that *Emblica officinalis* (amla), *Withania somnifera*

(ashwagandha), and *Curcuma longa* (turmeric) served to control lipid profiles, improve insulin sensitivity, and minimize inflammation (Murugan et al., 2025).

The immunomodulatory effects of specific Ayurvedic formulations received research attention when studying their impact on obesity alongside pre-diabetic health conditions. The experimental research on mice using Ayurvedic formulation therapy showed substantial body weight loss alongside decreased fat pad mass and lowered blood glucose levels and plasma insulin measurements. The formulation revealed immunomodulatory properties by altering inflammatory cytokines as per the research conducted by Yadav et al. (2011).

Clinical trial evidence and mechanistic insights

Numerous clinical research studies have tested the safety as well as efficacy of Ayurvedic medicine preparations. The study mainly focuses on the outcome of therapies alongside the mechanism of action and absorption rates. The assessment entails a critical review of adverse effects along with possible toxicity reviews and risk analyses to demonstrate the significance of quality control in patient safety. Clinical assessment examined the clinical efficacy of Nagarjunabhra Rasa as an Ayurvedic drug in patients with a history of myocardial infarction. This study demonstrated that Nagarjunabhra Rasa Ayurvedic formulation positively affected patients with myocardial infarction regarding angina and dyspnea (Sarkar and Mukhopadhyay, 2022).

Well-designed clinical trials have been done by modern pharmaceutical researchers to incorporate Ayurvedic practices. These trials are meant to establish strong evidence regarding the effectiveness of the Ayurvedic intervention to allow the traditional knowledge to be combined with modern medicine. Randomized Controlled Trials that are time-tested and compare Ayurvedic formulas to allopathic medicines consider both safety aspects and treatment effectiveness through a structured controlled approach (Mukherjee et al., 2017).

Case Studies Supporting Efficacy

Various research studies prove the effective treatment of various medical conditions using Ayurvedic treatments with efficient use cases in clinical practice. A research study was conducted to determine the effectiveness of traditional Siddha medicinal preparations in the treatment of jaundice. The patient was characterized by generalized weakness and lack of appetite, nausea, pain in the abdominal area, yellowish discoloration, and eyes. Siddha formulations applied to the treatment resulted in a significant reduction of symptoms in a jaundice patient as reported by Kumarasmy and Ramkumar (2022).

Scientists examined how effective Ayurvedic medicine is in clearing renal stones in patients. A multiple renal calculi patient was treated with Ayurvedic formulations that contained Varunadi Kashaya and Gokshuradi Guggulu along with Trivikram Rasa and Syrup Calcyl. The study demonstrated that the formulations were effective in removing left renal and ureteric calculi in one month following treatment based on the findings of the ultrasonography (Gill et al., 2024).

A case report showed the effectiveness of Ayurvedic prescription medication in the management of dyslipidemic chronic kidney disease (CKD). The patient was a 56-year-old hypertensive with a history of myocardial infarction, fatty liver disease, prostatomegaly, abnormal renal function, and dyslipidemia. Three Ayurvedic formulations were given to the patient and included Gokshurak Churna and Trinpachmula Kwath along with Arogyavardhini Vati. These formulations improved e-GFR and lipid profiles and creatinine serum levels after three months of treatment, thus demonstrating the potential of CKD management (Upadhyay and Pandey, 2023).

The application of Ayurvedic remedies in healthcare management is evident based on these case studies. The lessons learned need to be validated with large-scale clinical trials to prove wider clinical efficacy.

Ayurvedic Approaches in Neurological and Cognitive Health

Ayurveda is the Indian Ayurvedic medicine that proposes a holistic approach to health care by ensuring a balance between both the physical body and the mind, as well as a spiritual balance. Recent medical interest has focused on the evaluation of Ayurvedic approaches for treating neurological and cognitive health disorders, particularly those affecting anxiety and depression, and Alzheimer's and Parkinson's conditions. Research interest in Ayurvedic medicine has increased because of historical practices and new scientific findings validating these treatments (Narayana et al., 2023).

Mental health disorders of anxiety and depression affect the quality of life to a significant extent. Ayurveda attributes these conditions to imbalances in the body's fundamental energies, or doshas, particularly Vata and Kapha. Ayurvedic practitioners restore bodily equilibrium through the use of herbal medicine treatments combined with dietary adjustments and life modification techniques, and mind-body intervention methods. Traditional medicine utilizes herbs *Bacopa monnieri* (Brahmi) together with *Withania somnifera* (Ashwagandha) because they exhibit both calming and adaptogenic properties. Modern research validates these applications because *Bacopa monnieri* shows protective effects on the nervous system, which could help treat anxiety and depression, according to Sikarwar (2023).

Medical authorities encounter major hurdles when treating Alzheimer's disease along with Parkinson's disease since these neurodegenerative disorders advance steadily while standard medical interventions remain scarce. Through Ayurveda, patients can access different therapeutic approaches for managing their health conditions. Ayurvedic medicine targets two primary goals for Alzheimer's disease treatment by improving mental processing abilities and

reducing disease progression. The Ayurvedic practices use *Curcuma longa* (Turmeric) and *Bacopa monnieri* as medicinal plants because they possess both anti-inflammatory and antioxidant properties. These Ayurvedic medicinal plants were examined in Alzheimer's Research & Therapy through an evaluation that suggested the bioactive compounds could influence neurodegenerative processes (Chaudhry, 2024). The treatment strategy of Parkinson's disease under Ayurveda incorporates neuroprotective methods that both manage symptoms and enhance patients' quality of life. Traditional medicine incorporates *Mucuna pruriens* as an herbal formulation that provides natural levodopa to restore dopamine levels in the body. The neuroprotective aspect of Ayurvedic herbs received positive evaluation in a review article that outlined their usefulness in reducing oxidative stress while regulating neurotransmitters that aid Parkinson's disease treatment (Contin et al., 2015).

Experimental research methods help scientists understand how Ayurvedic interventions protect brain tissue. Laboratory tests demonstrated that *Bacopa monnieri* enhances mental operations and guards brain cells from harm in test animals, which strengthens its promise as a dementia prevention therapy. The research results match traditional knowledge and validate the potential use of these herbs in therapeutic plans for neurodegenerative diseases (Pham et al., 2019).

Multiple differences exist when studying Ayurvedic therapy against conventional allopathic medical approaches. Allodoxic clinical treatments achieve pain management primarily through drug-based methods, but these treatments sometimes produce negative side effects. Ayurvedic medicine develops specific therapies that remedy the origin of health imbalances by using natural substances that minimize negative results. A research examination confirmed that Ayurvedic treatments provide beneficial outcomes for managing long-term diseases since they deliver personalized care through natural approaches (Ahmad & Sharma, 2020). Mainstream healthcare requires additional attention to both the obstacles and restrictions when integrating Ayurvedic therapies. Researchers need to conduct additional rigorous clinical trials to develop standardized protocols in addition to dosage regimens for these remedies, despite increasing evidence about their efficacy. Standardized quality control systems must be implemented because herbal preparations show significant variations between different manufacturers.

Cardioprotective Potential of Ayurvedic Herbs

Throughout its long history, Ayurvedic medicine has discovered multiple botanical substances that demonstrate effective cardioprotective properties. Through traditional practices, people use *Terminalia arjuna* (Arjuna) and *Commiphora mukul* (Guggulu) as herbal remedies, which treat hypertension alongside atherosclerosis. Recent research studies have confirmed the traditional Ayurvedic practices by providing experimental and clinical evidence of their efficacy (Mounika et al., 2021).

Hypertension is high blood pressure that is a significant cardiovascular disease risk factor. Terminalia arjuna (Arjuna) bark has undergone scientific research to establish its ability to reduce blood pressure. Arjuna bark contains the therapeutic compounds tannins, flavonoids, and saponins. Experimental studies indicate that Arjuna has vasodilatory effects that initiate the relaxation of blood vessels and consequently reduce blood pressure levels. Studies agree that the antioxidant properties of Arjuna create positive impacts on endothelial function and nitric oxide levels that aid vascular health (Meghwani et al., 2017).

The heart attack and stroke risk increases because atherosclerosis produces plaques inside arterial walls, which cause artery narrowing and reduced elasticity. Scientific research indicates that Arjuna demonstrates potential to reduce atherosclerosis-related pathologies. The antioxidant and anti-inflammatory components of Arjuna work to stop lipid peroxidation and prevent vascular smooth muscle cell proliferation, which are essential factors in plaque development. Research on clinical patients demonstrates that Arjuna supplementation enhances lipid profiles through its ability to decrease total cholesterol and LDL levels and increase HDL levels, which results in an anti-atherogenic effect (Rather et al., 2016).

The Ayurvedic herb *Commiphora mukul,* which goes by the name Guggulu, has established itself as a powerful agent for heart protection. The bioactive compounds known as guggulsterones found in Guggulu exhibit proven ability to control lipid metabolic functions. Experimental research shows Guggulu has hypolipidemic properties that enable the liver to absorb more LDL cholesterol, which decreases the LDL cholesterol present in the blood. Guggulu demonstrates anti-inflammatory effects that protect against inflammatory mechanisms that cause atherosclerosis.

These herbs provide additional heart protection, which surpasses their lipid-modulating properties. The medical research shows that Arjuna treatment leads to better heart muscle performance and better exercise capacity in patients who have stable angina pectoris. The antioxidant properties of this compound defend myocardial tissue against the harmful effects of ischemia, thus limiting the size of heart damage. The anti-inflammatory and antioxidant properties of Guggulu help protect heart tissue from injury (Dwivedi & Chopra, 2014).

Ayurvedic Immunomodulators and Their Role in Infectious Diseases

The rich Ayurvedic practice has traditionally employed many herbs for immune strengthening and fighting against infectious diseases. Research has focused on three Ayurvedic herbs, *Withania somnifera* (Ashwagandha), *Tinospora cordifolia* (Giloy), and *Ocimum sanctum* (Tulsi) because of their proven immunomodulatory effects. Experimental

research along with clinical trials now demonstrates how these substances boost immunity and fight infections and help patients recover from COVID-19 (Shree et al., 2022).

***Ashwagandha* (*Withania somnifera*)**

Ayurvedic medicine uses Ashwagandha as Indian ginseng, to deliver its primary adaptogenic and immune-boosting functions. Studies conducted on Ashwagandha have proven that the medication elevates natural killer cell functions along with lymphocyte multiplication, which stabilizes immune responses in the human body. The immunomodulatory properties of Ashwagandha result from its bioactive compounds withanolides that demonstrate anti-inflammatory and antioxidant effects according to Pratte et al. (2014.

Multiple clinical studies have confirmed the effectiveness of Ashwagandha. The bioactive compounds in Ashwagandha extract demonstrated stress-reducing effects when given to test subjects, according to a double-blind, placebo-controlled study that also decreased anxiety levels. Both stress and anxiety negatively impact immune function. The reduction of stress through Ashwagandha treatment leads to improved immune health and better body resistance against infections (Bonilla et al., 2021).

***Giloy* (*Tinospora cordifolia*)**

The Ayurvedic community considers Giloy (*Tinospora cordifolia*) to be Guduchi because this plant possesses strong antipyretic effects alongside immunomodulatory properties. Research findings demonstrate that Giloy activates and stimulates macrophage production, which are vital immune response cells of the innate defense system. Giloy shows antimicrobial properties that fight against different pathogens such as bacteria and viruses, which demonstrates its potential use in treating various infectious diseases (Jyaswal, 2021).

Research has evaluated the effectiveness of this herb when treating patients during the COVID-19 pandemic. The Ministry of AYUSH in India conducted clinical trials with Giloy to evaluate its potential as an additional treatment for COVID-19 patients to improve immune function and decrease disease severity. Preliminary research shows Giloy, along with Ashwagandha and other herbs, may provide supportive benefits to manage COVID-19, according to Kul Karni et al. (2022).

***Tulsi (Ocimum sanctum*)**

Ayurvedic medicine recognizes Tulsi or Holy Basil as an essential plant among herbs because of its many healing abilities, thus earning it the title of "queen of herbs." The herb demonstrates significant antiviral and antibacterial properties along with anti-inflammatory effects, which makes it an important component for immune system enhancement. The scientific research shows that Tulsi activates T-helper cells and natural killer cells to strengthen immune defenses against pathogens (Mohapatra et al., 2023).

Traditional medical practices use Tulsi to reduce respiratory infection symptoms and speed up the healing process. People have widely added Tulsi to herbal teas and decoctions throughout the COVID-19 pandemic to boost their respiratory health and immune resistance. Traditional Tulsi use demonstrates its potential immune function support mechanism against viral infections, according to Jain et al. (2022).

Role in Post-COVID-19 Recovery

Acute COVID-19 infection results in numerous prolonged symptoms, which medical experts now label as "long COVID." The symptoms commonly experienced by patients include exhaustion, together with cognitive impairments and muscle weakness. Scientific studies have examined Ashwagandha as a potential remedy to manage symptoms that persist after COVID-19 infection. A clinical trial at the London School of Hygiene & Tropical Medicine, together with Indian research institutions, examined how Ashwagandha might help long COVID patients recover. The trial measures Ashwagandha's impact on energy levels, together with cognitive function and quality of life, because it demonstrates adaptogenic and restorative properties according to Chopra et al. (2022).

Evidence supports the combined therapeutic use of Giloy and Tulsi as a remedy for post-COVID care because they provide immune regulation benefits while combating inflammation. The immunomodulatory properties of these two substances together help restore the immune balance affected by viral infection to support complete recovery (Shree et al., 2022).

Cancer Therapeutics and Ayurveda

Ayurveda, as the traditional Indian system of medicine, has incorporated botanicals into therapy since ancient times to treat medical conditions with possible anticancer effects. Scientific studies have concentrated on curcumin, withaferin A, and neem extracts because researchers identify these compounds as potential cancer treatment agents. These agents demonstrate anticancer activity by triggering programmed cell death and blocking blood vessel development, and adjusting cellular oxidative stress levels. Chemotherapeutic drug combinations with botanical substances show promise for improving therapeutic benefits, according to Balachandran and Govindarajan (2005).

Curcumin

The polyphenolic compound curcumin, which originates from *Curcuma longa* (turmeric) rhizome, has become extensively researched for its anticancer properties. The compound modifies transcription factors, growth factors, and inflammatory cytokines to produce its anticancer effects. The cancer cell apoptosis process begins when curcumin activates caspases and reduces Bcl-2 and other anti-apoptotic proteins. The suppression of vascular endothelial growth factor (VEGF) and its receptors through curcumin treatment blocks angiogenesis, thus preventing tumor growth and metastasis. Curcumin functions as an antioxidant because it reacts with free radicals known as ROS and decreases their impact on cellular stress, which drives cancer progression. Studies involving human patients have evaluated how curcumin works with chemotherapy treatments. A systematic review showed curcumin increases the power of chemotherapy and radiotherapy treatments while extending patient survival times, while minimizing adverse effects that lead to better cancer patient quality of life (Buch et al., 2012).

Withaferin A

The steroidal lactone Withaferin A shows powerful anticancer properties because it comes from *Withania somnifera* (Ashwagandha). Through ROS production and stress-related pathway activation, aferin A causes cancer cell apoptosis. The compound Withaferin A blocks angiogenesis through its ability to decrease VEGF production and other pro-angiogenic factors. Withaferin A protects normal cells from oxidative damage through its ability to increase antioxidant enzyme expression, which reduces oxidative stress. Preclinical research shows how withaferin A makes cancer cells more sensitive to chemotherapy treatments, thus indicating its value as an additional cancer therapy (Saggam et al., 2020).

Neem Extracts

Traditional Ayurvedic medicine incorporates Neem (*Azadirachta indica*) extracts because they show multiple therapeutic properties, which include anticancer benefits. The cancer cell apoptosis process is triggered by nimbolide and azadirachtin compounds found within neem, which modify apoptotic signaling pathways. The anti-angiogenic properties of neem extracts occur when they lower VEGF expression while blocking endothelial cell growth. The antioxidant properties of neem reduce oxidative stress, which protects DNA from damage and stops cancer from developing further. Experimental research demonstrates that neem extracts improve the effectiveness of chemotherapeutic drugs, thus indicating their value for combination treatments (Batra et al., 2022).

Mechanisms of Action

Curcumin along with withaferin A, and neem extracts exhibit their anticancer properties through apoptosis induction and angiogenesis inhibition, and oxidative stress regulation. Programmed cell death, known as apoptosis, functions as a vital target during cancer treatment activities. The compounds activate two distinct pathways of programmed cell death, which result in cancer cell destruction. The compounds prevent angiogenesis, which enables new blood vessel formation, because new blood vessel formation supports tumor growth and metastasis. These agents suppress VEGF and other pro-angiogenic factors, which prevent tumors from acquiring vital nutrients. The antioxidant properties of these compounds decrease oxidative stress, which results in reduced DNA damage and prevents cancer from advancing (Macharia et al., 2022).

Combination Therapy with Chemotherapy

Scientific studies investigate combining these traditional Ayurvedic substances with conventional cancer treatments with the dual purpose of increasing therapeutic potency while decreasing adverse effects. Research on advanced breast cancer patients with paclitaxel chemotherapy combined with curcumin has been studied through clinical trials. The research investigates how curcumin affects chemotherapy benefits as well as treatment results for patients. Research findings indicate that withaferin A and neem extracts make cancer cells more receptive to chemotherapy treatments, which leads to increased effectiveness of standard cancer therapies (Metri et al., 2013).

Ayurvedic Gastrointestinal and Hepatic Therapies

Ayurveda, as the traditional Indian medical system, provides a complete approach for maintaining gastrointestinal and hepatic health by using different herbal remedies. The traditional medicines Triphala, Aloe Vera, and Kutki have gained extensive use for their therapeutic properties. The Ayurvedic formulation Triphala consists of three fruits that include Amalaki (*Emblica officinalis*), Bibhitaki (*Terminalia bellirica*), and Haritaki (*Terminalia chebula*). The mixture of these three herbs is highly valued because it supports digestive health by functioning as a gentle laxative while also cleaning the gastrointestinal tract. People who consume Triphala regularly experience dosha balance, especially for Vata and Pitta, which supports the entire digestive system. The scientific research shows that Triphala assists liver detoxification while improving hepatic function and helping the body eliminate toxins (Peterson et al., 2017).

Ayurvedic medicine identifies Aloe Vera (*Aloe barbadensis*) as a key herb because it provides soothing and healing benefits to the body. Traditional use of Aloe Vera juice in gastrointestinal health includes treatment of constipation and

acid reflux, and irritable bowel syndrome (IBS). The anti-inflammatory properties of this herb help calm down the digestive tract lining while it reduces irritation and heals the area. The healing properties of Aloe Vera help detoxify the liver while improving its function, which supports metabolic equilibrium 9Sahu et al., 2013).

Medical science recognizes Kutki (*Picrorhiza kurroa*) as an important agent that protects the liver. Traditional medical practitioners use this herb to treat liver diseases, including jaundice, hepatitis, and cirrhosis. Kutki functions as a digestive bitter that helps to enhance bile output along with digestion processes, while it enables liver detoxification. The protective effects of hepatic tissue from damage are supported by both anti-inflammatory and antioxidant properties of this remedy.

These medicinal herbs find clinical use in treating IBS, and they help manage the composition of gut bacteria. Science has proven that the herbal medicine Triphala contains antimicrobial properties that support digestive health by maintaining a healthy balance of gut flora to treat symptoms of IBS. Aloe Vera contains soothing agents that help decrease gut inflammation, thus reducing IBS symptoms. The bile secretion enhancement function of Kutki helps digestion and creates an optimal environment for microbiome health, according to Kumari et al. (2021).

Skin and Dermatological Applications of Ayurveda

Through natural formulations, Ayurveda provides extensive knowledge about treating skin disorders by selecting herbs that have healing properties, reduce inflammation, and promote skin rejuvenation. Different wound healing formulations from Ayurvedic medicine exist to improve tissue restoration and tissue regeneration. Medical researchers have developed and tested transdermal herbal patches containing *Curcuma longa* (turmeric) and Aloe vera to evaluate their healing properties in wounds. These therapeutic delivery systems attach to wound areas to provide ongoing drug release, which helps fight inflammation and generate new tissue (Narahari et al., 2018). Ayurvedic medicine has developed interventions to treat psoriasis, which represents a chronic inflammatory skin condition. The treatment of psoriasis through Ayurvedic medicine has led to positive findings in patient outcomes and symptom relief in case-based evaluations. The therapeutic approach includes customized herbal medications taken by mouth and skin treatments that doctors adjust based on patient constitution and disease characteristics (Abraham et al., 2019).

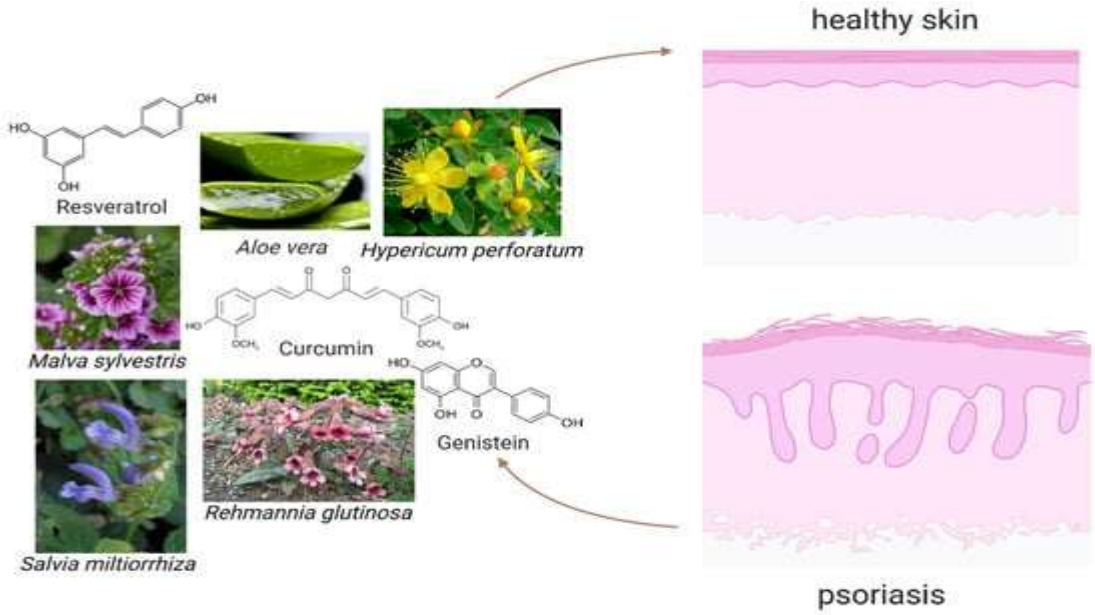

Figure 2: The chosen plants and phytochemicals present in this scheme show potential to alleviate psoriasis symptoms as well as act as antiproliferative compounds for psoriatic keratinocytes (Nowak-Perlak, 2023).

Challenges and Limitations in Ayurvedic Research

The widespread acceptance of Ayurvedic research remains limited because it encounters various obstacles that prevent its integration into contemporary medical systems. A principal barrier arises from inadequate standardization, along with poor quality control procedures for Ayurvedic medical solutions. Standardizing Ayurvedic medicines becomes difficult because they contain multiple herbal substances, which makes it hard to maintain consistent compositions and potency levels, and bioavailability measurements. Standardization becomes more challenging because raw materials show variations from plant species differences, geographical conditions, and different harvesting methods. The safety and effectiveness of Ayurvedic products face risks because of heavy metal and pesticide contamination and microbial

impurities found in them. The maintenance of product integrity requires compound analytical methods for total quality control to build consumer trust.

Ayurvedic drugs face major obstacles because of the difficulties involved in obtaining regulatory approval for these products. Ayurvedic formulations evade comprehensive FDA/EMA regulation since they do not meet well-established approval standards that contemporary pharmaceutical products need. The market availability of traditional medicines remains inconsistent because different countries maintain separate regulatory systems for these medicines. Ayurvedic therapies face restrictions in international growth because of the lack of universal regulatory standards, which require policy harmonization for international safety and efficacy standards compliance.

The scientific recognition of Ayurvedic interventions requires extensive clinical trials together with contemporary validation approaches to prove their medical validity. Ayurvedic formulations derive their base from historical practices instead of having sufficient clinical evidence to support them. Current research on Ayurvedic treatments produces promising results, yet randomized controlled trials (RCTs) remain scarce, together with explanatory findings that match contemporary biomedical investigation criteria. Ayurveda can obtain greater acceptance in conventional healthcare by uniting with present-day research tools, including genomics along with metabolomics, and bioinformatics methods. This unification will boost its scientific validation. To advance Ayurveda toward evidence-based medical status, researchers and interdisciplinary teams must work together while investing in high-quality research projects.

Future Perspectives and Research Opportunities

The advancement of Ayurvedic research now depends on technological integration with nanotechnology and biotechnology to enhance herbal compound delivery systems, which will produce more effective Ayurvedic formulas. Personalized Ayurvedic medicine through the use of AI is highly promising to develop treatments that correspond to the individual, such as predispositions and genetics, and lifestyle factors, to optimize therapeutic outcomes. The field of Ayurveda-based pharmaceuticals continues to grow because scientific research on herbal compounds leads to their acceptance in evidence-based medical treatments. Research collaboration between different fields will enhance Ayurvedic medicine's standing while making it more acceptable worldwide in current medical practices.

Conclusion

Strong therapeutic uses of Ayurveda extend throughout different health areas, including metabolic diseases, along with neurologic diseases, coronary heart health problems, and immune system regulation. The review demonstrates how scientific evidence confirms the effectiveness of Ayurvedic formulations, including Curcumin, Withania somnifera, Terminalia arjuna, and Tinospora cordifolia, since these herbs show substantial pharmacological properties. Multiple experimental studies and clinical research show that these traditional medicines function as treatments through anti-inflammatory actions, antioxidative protection, brain protection, and heart protection, thus supporting their use as alternative medical solutions. The widespread medical system integration of Ayurveda faces barriers due to limits in standardization practices and difficulties achieving quality control, together with obtaining regulatory approvals.

The worldwide transition toward natural and integrative medicine creates a substantial impact on healthcare and future research because Ayurvedic interventions have gained increased attention. The application of research techniques combining nanotechnology with biotechnology and artificial intelligence permits better access to Ayurvedic treatments that demonstrate enhanced efficiency and scientific approval standards. Additional clinical investigations, together with pharmacokinetic analyses and bioinformatics research, must be conducted to prove their safety profile and determine their effectiveness and method of operation.

A complete exploitation of Ayurvedic potential requires industrial collaboration between traditional medical professionals and biomedical investigators, as well as pharmaceutical companies. A worldwide acceptance of evidence-based Ayurvedic medicine as a medical system can become a reality when scientists combine modern techniques with traditional Ayurvedic wisdom. Applied research facilities, together with regulatory protocols and international agreements between institutions, will establish Ayurveda as a complementary health solution to mainstream medicine for the future.

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