Role of Rasa Shastra in the Management of Chronic Disorders: An Integrative Ayurvedic and Nanomedicine Perspective

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ABSTRACT

Abstract

Background: Globally, the prevalence of chronic illnesses such diabetes mellitus, autoimmune diseases, arthritic disorders, and neurodegenerative diseases is increasing, placing a heavy burden on modern healthcare systems. Chronicity, according to Ayurvedic philosophy, is the long-term derangement of *dhatu* and *agni* caused by the persistent interaction of *dosha* and *dushya*. Because of its *sukshma, vyavayi*, and *ashukari* qualities, Rasa Shastra, the alchemical branch of Ayurveda that deals with herbo-mineral formulations, offers extremely powerful therapeutic agents that operate quickly and persistently in chronic systemic illnesses.

Methodology: Using contemporary scientific resources like PubMed, SpringerLink, and the AYUSH Research Portal, as well as traditional Ayurvedic compendia like the Charaka Samhita, Rasa Tarangini, and Rasa Ratna Samucchaya, a narrative review was carried out. Included were texts and articles about the use of *rasa aushadhi* in the treatment of chronic illnesses. Studies addressing the safety, clinical results, and pharmacological mechanisms of *rasa* and *bhasmayogas* were examined.

Discussion: According to research, correctly prepared *rasa aushadhi*, such as Suvarna Malini Vasant, *Abhraka Bhasma*, and *Rasa Sindura*, have anti-inflammatory, immunomodulatory, and restorative properties. According to the principles of contemporary nanomedicine, metals are transformed into safe and bioavailable nanotherapeutic forms through the special *shodhana* and *maraṇa* procedures. In order to reverse chronic disease, *Rasa Rasayana* supports *agni*, improves *ojas*, and encourages cellular regeneration.

Conclusion: Rasa Shastra offers a method for managing chronic diseases that is based on philosophy and science. It has great potential for creating individualized and long-lasting treatment plans in the field of global healthcare when standardized and combined with contemporary evidence-based techniques.

Keywords: Rasa shastra, Rasa Aushadhi, Chronic diseases Bhasma, Immunomodulation, Bioavailability.

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INTRODUCTION

Chronic diseases, known in Ayurveda as chirakalinavyadhi, pose a significant threat to global health because of their protracted course, escalating pathology, and limited capacity for cure. Non-communicable diseases, such as diabetes mellitus, chronic respiratory ailments, cancer, autoimmune diseases, cardiovascular disorders, and neurodegenerative diseases, account for more than 70% of global mortality, according to the World Health Organization.

[1] Effective long-term management of chronic illnesses is still challenging, despite significant breakthroughs in surgical techniques, pharmaceutical interventions, and diagnostic techniques. The majority of conventional medical therapies concentrate on controlling symptoms rather than treating the underlying illness, which frequently leads to long-term medication dependence, negative side effects, and a reduced quality of life.[2] In light of this, Ayurveda, the Indian traditional medical system, offers a thorough and all-encompassing approach that places an emphasis on prevention, individualized treatment plans, and long-term health restoration.

According to Ayurvedic pathology, *agnimandya* (deranged metabolic activity), *srotorodha* (obstruction of body channels), and *doṣha–duṣhyasammurchana*—which reflects the prolonged pathogenic interaction between bodily humors and tissues—are responsible for the development of chronic disorders. Long-term

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persistence of these pathogenic variables without prompt or suitable care results in *rogaupadrava (secondary complications) and vyadhidirghakaritva (chronic progression of disease*). Conditions like *dirghakalaanubandhivyadhi*, which are difficult to heal because of ingrained *doṣhic* imbalance, gradual tissue depletion, and reduced *ojas* (vital essence), are described in the Charaka Saṃhita.[3]. To interrupt this pathological process, Ayurveda advocates a comprehensive therapeutic approach that includes *nidanaparivarjana* (avoidance of etiological factors), *samana* (palliative measures), *sodhana* (biopurificatory therapies), and *rasayana chikitsa* (rejuvenative treatment).

The Ayurvedic approach views each person as a psychosomatic entity with distinct constitutional traits (*prakṛti*), which is a major departure from the contemporary biomedical paradigm. As a result, Ayurvedic treatment of chronic illnesses is dynamic and individualized, treating mental, emotional, and lifestyle aspects in addition to physical symptoms.

The Emergence and Significance of Rasa Shastra

In the classical Ayurvedic system, Rasa Shastra emerged as a separate and specialized field focused on *rasa dravya*, which includes metals, minerals, and mercury-based compounds, with the aim of creating extremely powerful, quick-acting, and long-lasting medicinal agents. *Rasa* signifies both "mercury" and "essence," signifying the deep philosophical and therapeutic roots of this field of study. An important and revolutionary development in the development of Ayurvedic treatments is the conversion of Rasa Shastra from its roots in Tantric alchemical rituals (*Rasa Vidya*) into a systematic medicinal discipline.[4].

Long dosing times were frequently necessary for conventional herbal preparations to yield noticeable therapeutic results, especially in chronic and resistant illnesses. Advanced *sodhana* (purificatory) and *maraṇa* (calcination) procedures were used to synthesize *rasaaushadhis* in order to overcome these constraints. These approaches increase bioavailability while reducing toxicity. Raw minerals and metals including *parada* (mercury), *gandhaka* (sulphur), *tamra* (copper), *loha* (iron), *abhraka* (mica), and *suvarṇa* (gold) are transformed into therapeutically effective, biocompatible, and nano-structured *bhasma* preparations through these specialized methods. [5]

The *sukṣhma* (subtle), *vyavayi* (pervasive), and *ashukari* (rapid-acting) properties of Rasa Shastra drugs enable them to act at the cellular level and penetrate deep tissues; additionally, their *yogavahi* property enhances the action of co-administered herbal medicines, making them essential for the treatment of degenerative and chronic diseases.[6]

Rasa Shastra and the Ayurvedic Concept of Chronic Diseases

The fundamental level of *doṣha–dhatu–agni–srotas* control is where *rasa aushadhis* and rasa treatment work in chronic illnesses like *pakṣaghata* (paralysis), *madhumeha* (diabetes mellitus), and *amavata* (rheumatoid arthritis). For example, a *kapha*-dominant *tridoṣhaja* imbalance linked to poor medo dhatu metabolism is a hallmark of the pathophysiology of *madhumeha*. Formulations such *Rasa Sindura* and *ArogyavardhiniVaṭi* help with detoxifying, balance lipid metabolism, and promote *agni* in these situations [7]. Similarly, *Abhraka Bhasma* acts as a potent *rasayana*, encouraging tissue regeneration and general vigor, while *Suvarṇa MaliniVasant Rasa* improves *ojas* and immune competence.

Charaka highlights that *nidanarthakararogas*, or secondary disorders resulting from inadequate therapy of basic sickness, are the cause of chronic diseases [8]. By cleansing tissues, reviving *agni*, and enhancing *ojas*, Rasa Shastra medicines—which are *rasayana-yukta* and *balya*—can reverse chronicity. Panchakarma, dietary adjustments, and rasa *aushadhi* together create a comprehensive trio for managing chronic illnesses.

Scientific Correlation and Modern Validation

Numerous fundamental ideas of Rasa Shastra now have experimental backing because to recent advancements in analytical chemistry and nanotechnology. Studies using X-ray diffraction (XRD), energy-dispersive X-ray spectroscopy (EDX), and transmission electron microscopy (TEM) have shown that properly prepared *bhasma* is composed of metallic nanoparticles embedded in an organic matrix made from herbal processing media [9]. When compared to unprocessed metallic versions, these nanoparticles, which are usually between 10 and 50 nm in size, exhibit enhanced bioavailability and noticeably reduced toxicity.

Additionally, research has shown that formulations based on *rasa dravya* have anti-inflammatory, antioxidant, immunomodulatory, and neuroprotective qualities [10]. *RasaSindura*, for instance, shows promise in neurodegenerative illnesses by protecting mitochondria and lowering oxidative stress in brain cells. In experimental models, *TamraBhasma* and *Loha Bhasma* have also demonstrated hepatoprotective and hypoglycemic effects [11].

The *shodana* process—unique to *Rasa Shastra*—is now understood as a method of detoxification and chemical transformation. Repeated incineration

with plant juices or decoctions results in organo-metallic complexes that mitigate heavy metal toxicity. Therefore, the safety of *rasa aushadhi* depends critically on the authenticity of raw material, adherence to classical methods, and proper *maraṇa* cycles [12].

Integration of Rasa Shastra with Modern Medicine

The use of Rasa Shastra in the treatment of chronic illnesses has rekindled scientific and clinical interest due to the global shift toward integrative and individualized healthcare. By reducing side effects, boosting immune responses, and improving overall therapeutic results, *rasa aushadhis* may serve as supplemental medicines in addition to traditional treatment for diseases like cancer, autoimmune diseases, and metabolic syndromes. Notably, formulations of *Suvarṇa Kalpa* are being studied for their cytoprotective and immunomodulatory qualities, which closely align with modern oncological treatment principles.[13]

The pharmacodynamic similarities between *rasa dravya* and nano-drug delivery devices are highlighted in research that are indexed by Springer. *Bhasma's sukṣma* and *vyavayi* qualities align with the ideas of prolonged release and cellular targeting. Rasa Shastra thus serves as a link between traditional nanomedicine and modern pharmacology.[14]

Global Relevance and Research Challenges

Even though Ayurveda is becoming more well-known worldwide, there are still issues with *rasa aushadhis's* standardization, quality assurance, and international acceptance. Strict quality assurance is required due to worries about heavy metal contamination, which is frequently the result of faulty or fabricated preparations. The lack of free hazardous metals in authentic preparations has been verified analytically by methods such as atomic absorption spectroscopy, XRD, and ICP-MS [15]. A thorough pharmaco-toxicological framework that combines Ayurvedic knowledge with contemporary scientific rigor is urgently needed.

Both contemporary biomarkers (oxidative stress, inflammatory cytokines, mitochondrial function) and Ayurvedic indicators (*prakṛti*, *doṣha* state, *agni*, *srotas*) should be included in the study process for assessing *rasaaushadhi*. When combined with reverse pharmacology and systems biology techniques, randomized controlled trials can provide reliable proof for widespread acceptance.[16]

METHODOLOGY

The current review takes a narrative and integrative approach, referencing existing clinical research on the application of Rasa Shastra in the treatment of chronic illnesses as well as traditional Ayurvedic scriptures and modern scientific literature. With components of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards that have been appropriately modified for the analysis of Ayurvedic textual sources, the methodological approach adheres to accepted norms of evidence-based review writing. This review's goal was to provide a thorough understanding of the pharmacological importance and therapeutic usefulness of *rasa aushadhis* in the treatment of chronic disorders by critically assessing both contemporary biomedical evidence and ancient Ayurvedic beliefs.

The review focused on three key aspects:

1. Ayurvedic conceptual framework of chronic diseases (*chirakalinavyadhi*).
2. Therapeutic principles and formulations of *Rasa Shastra*.
3. Modern validation, pharmacodynamics, and safety evaluation of *rasa dravya*-based medicines.

The Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Rasa Ratna Samuccaya, Rasa Tarangini, and Bhaishajya Ratnavali are among the source works from which the classical Ayurvedic data were extracted. To put the pharmacological justification for rasa dravyas in context, commentary by Chakrapanidatta, Dalhana, and Vagbhata was also studied. Peer-reviewed publications listed in PubMed, SpringerLink, Scopus, and Google Scholar were among the contemporary data sources. "Ayurveda," "Rasa Shastra," "chronic diseases," "bhasma safety," "metal-based Ayurvedic formulations," "nanomedicine," and "rasayana therapy" were among the search terms used. To guarantee the inclusion of both fundamental and contemporary works, the search period encompassed publications from 1990 to 2025.

After screening, a total of 108 sources met the inclusion criteria, including 17 classical references, 71 journal articles, and 20 contemporary review papers.

Data Extraction and Analysis

The retrieved data were organized into thematic subgroups to allow integrative interpretation:

1. **Ayurvedic Pathophysiology of Chronic Disorders:** based on *doṣa-dhatu-mala-agni-srotas* involvement and *sampraptivighatana* principles.
2. **Therapeutic Modalities in Chronic Diseases:** focusing on *samana*, *sodhana*, *rasayana*, and *rasa aushadhi* applications.

3. **Pharmacotechnical Aspects of Rasa Shastra:** including *sodhana*, *maraṇa*, *amṛtikaraṇa*, and *putapaka* processes.
4. **Modern Scientific Validation:**analyzingnanostructural characteristics, pharmacokinetics, and toxicity profiles.
5. **Clinical Applications and Case Reports:** highlighting *rasa aushadhi*-based treatment outcomes in chronic diseases such as *madhumeha*, *amavata*, *pakṣaghata*, *kṣaya*, *kasa*, and *chronic skin disorders*.

The extracted data were compared across Ayurvedic classical theory and modern biomedical evidence to ensure consistency and correlation.

Data Synthesis and Interpretation

Correlating Ayurvedic theory with contemporary findings was part of the data synthesis process. The *doṣha–dhatu–mala–agni* framework was used for the conceptual analysis, and immunomodulation, antioxidant mechanisms, and mitochondrial stability were used to interpret the current data.

DISCUSSION

Understanding Chronicity in the Ayurvedic Context

Chronic disorders (*chirakalinavyadhi*) in Ayurveda are caused by *doṣhaduṣhṭi* that persists over time, *srota* blockage, and *dhatu sara* depletion. Systemic dysfunction results from the continual action of *nidana* (etiological causes), which disrupt *agni* (metabolic fire) and produce *ama* (metabolic poisons) that go through rasa and *raktadhatu* [17]. The current understanding of oxidative stress, immunological dysregulation, and chronic inflammation aligns with this progressive pathophysiology [18].

This chronic process is called *vyadhisaṃprapti* in Ayurvedic scriptures. If *doṣhas* delve deeper into *dhatu* layers, it may become *kṛcchrasadhya* (difficult to cure) or asadhya (incurable). In order to prevent chronicity, Ayurveda promotes early intervention through *rasayanaprayoga* and *doṣha-pratyanika chikitsa* [19].

Here, Rasa Shastra is important because it provides strong rasa aushadhis that, because of their *sukhṣma* and *vyavayi* character, can penetrate subtle channels. These formulations work at the *moola hetu* (root cause) as well as the symptom level by reviving *dhatu* function, eliminating *srotorodha*, and rekindling *agni* [20].

Rasa Shastra: Alchemical Science with Therapeutic Precision

Known as the "Alchemy of Ayurveda," Rasa Shastra developed as a specialist field to create medications that are both long-lasting and fast-acting. More than 500 herbo-mineral formulations were described by classical *rasavaidya* such as Nagarjuna, *Vagbhata*, and Govinda Bhagavatpada with the intention of treating persistent and chronic illnesses [21]. Toxic raw materials are transformed into biocompatible forms known as *bhasma* by means of *shodana* (purification) and *maraṇa* (calcination) in metals and minerals [22].

This advanced pharmaceutics foreshadowed contemporary nanotechnology. *Bhasmas* contain particles between 50 and 200 nm, frequently in the form of metal oxides or organometallic compounds, according to studies conducted using X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) [23, 24]. The addition of *shodhana dravya* herbal ligands, such as *triphala*, aloe vera, and citrus limon, further stabilizes the particles and improves their bioavailability [25].

In line with contemporary pharmacokinetics concepts, such nanoscale change permits tailored therapeutic activity and deeper cellular penetration. As a result, Rasa Shastra combines pharmaceutics, pharmacognosy, and metallurgy to represent an indigenous kind of "green nanomedicine" [26].

Pharmacodynamics and Mode of Action

The therapeutic mechanism of *rasa aushadhis* can be elucidated through classical as well as modern scientific paradigms.

a. Classical Perspective

According to *Rasa Ratna Samuccaya* and *Rasa Tarangini*, *rasa dravya* possess *trividha karma*:

1. *Doṣhasamana* (pacification of vitiated humors),
2. *Dhatu poshana* (nourishment of tissues), and
3. *Ojas vardhana* (enhancement of vitality and immunity) [27].

Their *yogavahi* nature allows synergistic potentiation of accompanying herbal drugs, ensuring selective tissue targeting. For instance, *Suvarna Bhasma* enhances the efficacy of *Guduchi*, *Ashwagandha*, and *Shilajatu* when administered together [28].

b. Modern Correlation

These compositions exhibit antioxidant, immunomodulatory, and mitochondria-protective qualities from a modern biomedical perspective. According to experimental research, *Suvarṇa Bhasma* and *Rasa Sindura* improve mitochondrial enzymatic function and control the generation of

reactive oxygen species (ROS) [29]. Because of its iron-silicate compounds, which stimulate hematopoiesis and encourage tissue repair processes, *Abhraka Bhasma* promotes cellular regeneration [30]. Furthermore, compared to traditional ferrous iron preparations, *Loha Bhasma* minimizes oxidative stress by acting as a sustained-release source of iron [31].

In chronic metabolic disorders like diabetes or rheumatoid arthritis, *rasa aushadhis* reduce systemic inflammation and improve antioxidant status, paralleling the effects of modern immunotherapeutics but without cumulative toxicity [32].

Table 1: Representative Rasa Dravya and their Application in Chronic Diseases

Rasa Dravya / Bhasma	Primary Action	Ayurvedic Indication	Modern Correlate
Suvarna Bhasma	*Rasayana, Medhya, Ojasvardhaka*	*Madhumeha, Kṣaya, Pakṣaghata*	Immunomodulator, Neuroprotective
Abhraka Bhasma	*Vataghna, Balya, Dhatu vardhaka*	*Chronic Asthma, Tuberculosis, Neurological Disorders*	Regenerative, Antioxidant
Loha Bhasma	*Raktavardhaka, Dipana*	*Paṇḍu, Prameha*	Iron supplement, Antianemic
Rasa Sindura	*Agnidipaka, Yogavahi*	*Kṣaya, Prameha, Kasa*	Mitochondrial protector, Detoxifier
Tamra Bhasma	*Lekhana, Dipana*	*Medoroga, Yakṛtvikara*	Lipid-lowering, Hepatoprotective

Table 1 presents key examples of *rasa dravya*, their Ayurvedic actions, and related chronic disorders.

Clinical Applications of Rasa Shastra in Chronic Disorders

The versatility of *Rasa Shastra* lies in its ability to modulate systemic and cellular processes across disease spectrums.

a. Metabolic and Endocrine Disorders

Formulations including *SuvarṇaMaliniVasant Rasa*, *Loha Bhasma*, and *Rasa Sindura* have therapeutic effects in *madhumeha* (diabetic mellitus) by increasing *agni* (metabolic efficiency) and insulin responsiveness. When these preparations are used in combination with *NishaAmalaki* or *Vijayasara* decoctions, clinical observations and experimental research reveal improved lipid profiles and better glycemic management [33]. Additionally, *Suvarṇa's* adaptogenic potential is demonstrated by its *rasayana* effect, which is linked to the preservation of pancreatic β-cell function and the mitigation of microvascular problems [34].

b. Neurological and Degenerative Diseases

In *pakṣaghata* (stroke) and *kampavata* (Parkinsonism), *Abhraka Bhasma* and *Suvarna Bhasma* combined with *Ksheerabala Taila* and *Brahmi Ghrita* improve neuronal repair and cognitive function. Preclinical studies suggest neuroprotective effects via modulation of acetylcholinesterase activity and synaptic plasticity [35,36].

c. Musculoskeletal and Autoimmune Disorders

Rasa Sindura and *Yogaraja Guggulu* exhibit analgesic and anti-inflammatory properties similar to those of non-steroidal anti-inflammatory medications (NSAIDs) but with less gastrointestinal side effects in *amavata* (rheumatoid arthritis) and *sandhivata* (osteoarthritis) [37]. The combination works by restoring *agni* and rectifying *ama buildup*, which in biological words translates to metabolic regulation and detoxification.

d. Respiratory and Immune-Deficiency Disorders

Formulations like *Suvarna Vasant Malti Rasa* and *Abhraka Bhasma* have been successfully used in chronic respiratory ailments such as *kasa* (chronic cough), *svasa* (asthma), and *rajayakṣma* (tuberculosis) [38]. Their *rasayana* and *immunostimulant* properties are validated by modern studies showing enhanced macrophage activation and cytokine modulation [39].

e. Chronic Skin and Hepatic Disorders

TamraBhasma and *Rasa Parpati* act as lekhana (scraping) and *dipana* (digestive stimulant) agents in *kustha* (chronic dermatological diseases) and *yakṛtvikara* (hepatic disorders), enhancing detoxification pathways and liver function [40]. Copper-based bio-complexes that support lipid metabolism and antioxidant defense are revealed by nanochemical investigation [41].

Figure 1: Mechanistic Model of Rasa Shastra in Chronic Disease Management

1. ***Shodhana* (Purification)** → Detoxification of metal → Formation of organometallic complexes.
2. **Maraṇa (Incineration)** → Conversion to nano-particles → Enhanced tissue permeability.

3. **Administration with *Anupana* (Vehicle)** → Targeted delivery → Systemic distribution.
4. **Pharmacological Action** → *Agni dipana, Doṣa samana, Dhatu poshana*.
5. **Clinical Outcome** → Symptom relief, tissue regeneration, improved *ojas*, and reversal of chronic pathology.

Rasa Rasayana: Rejuvenative and Preventive Potential

The concept of *Rasayana* in Ayurveda denotes the rejuvenation of body tissues, prevention of premature aging, and enhancement of immunity (*vyadhi-kṣamatva*). *Rasa Rasayana* refers to *rasa aushadhi* formulations with pronounced *rasayana* effects, including *Suvarna Bhasma*, *Abhraka Bhasma*, and *Makṣika Bhasma* [42]. These agents strengthen *ojas* and counteract tissue degeneration.

These findings are supported by recent scientific studies, which show that *Abhraka Bhasma* enhances mitochondrial function and cellular oxygen utilization, while *Suvarṇa Bhasma* increases the activity of important antioxidant enzymes, such as superoxide dismutase (SOD) and catalase [43]. These physiological impacts have a striking resemblance to the mechanisms outlined in regenerative and anti-aging therapies. As a result, *Rasa Rasayana* formulations show promise as a therapeutic category for the treatment of long-term conditions linked to immunological dysfunction or degenerative alterations.

Integration of Rasa Shastra with Modern Medicine

In order to improve clinical outcomes, integrative healthcare approaches place a strong emphasis on the prudent combination of contemporary biomedical treatments with traditional remedies that have been scientifically verified. In this context, Rasa Shastra formulations could serve as supplementary substances to contemporary pharmaceutical treatments. For example, research has shown that *SuvarṇaBhasma* used in conjunction with low-dose corticosteroids can lower pro-inflammatory cytokine activity and lessen steroid reliance in rheumatoid arthritis patients [44]. Similarly, compared to traditional iron preparations, *LohaBhasma* has been demonstrated to function as a safer substitute for iron supplementation in cases of chronic anemia, with a decreased tendency to cause oxidative stress [45].

Integration must, however, follow safety regulations and scientific rigor. For efficacy and risk reduction, standardization of *bhasma* preparation, validation of *shodana* procedures, and regular heavy-metal testing are crucial [46]. Particle characterisation, the lack of free metal content, and clinical monitoring are among the pharmacopoeial standards for *rasaaushadhi* quality assurance that have been established by the Ministry of AYUSH and WHO [47].

Addressing Safety Concerns and Misconceptions

Critics often highlight the potential for heavy-metal toxicity in *rasa aushadhi*. However, classical *Rasa Shastra* distinctly emphasizes proper *shodana* and *maraṇa* procedures that transform toxic metals into safe, bio-assimilable compounds [48]. Studies employing ICP-MS and AAS analyses confirm that correctly prepared *bhasma* contains metals in inert, organometallic, or oxide forms within permissible WHO limits [49].

According to toxicological assessments, *SuvarṇaBhasma* and *RasaSindura* do not cause hepatic or renal toxicity when taken in therapeutically recommended dosages and prepared in accordance with traditional standards, but poorly processed or fake formulations can be extremely harmful [50]. To guarantee clinical safety, these formulations must be rigorously standardized and authenticated. Furthermore, the idea of systemic detoxification rather than tissue accumulation has been supported by the positive hematological and biochemical results linked to long-term usage of appropriately produced *rasaaushadhis* [51].

Scientific Convergence: Rasa Shastra and Nanomedicine

Rasa Shastra and contemporary nanoscience are strikingly similar. Metals can be converted into *bhasma* by repeatedly calcining them, which produces high-surface-area nano- and micro-sized particles that improve bioavailability and solubility [52]. This is similar to contemporary drug delivery techniques that use metallic nanoparticles for targeted distribution and sustained release.

For instance, in low concentrations, the sulphur and mercury nanoparticles in *RasaSindura* form structures like cinnabar, which have protective effects on the mitochondria and antioxidant properties [53]. Likewise, *SuvarnaBhasma* exhibits gold nanoparticles (20–50 nm) attached to chemical ligands, which may have use in immunomodulation and neuroprotection [54].

Rasa Shastra can therefore be considered an early forerunner of Ayurvedic nanomedicine, thereby bolstering its incorporation into modern pharmacological research frameworks.

Summary of Key Findings

Aspect	Ayurvedic Insight	Modern Correlation
Chronicity	*Doṣhaduṣhṭi*, *agnimandya*, *ama sanchaya*	Chronic inflammation, metabolic dysfunction
Rasa Aushadhi Property	*Sukṣhma, Vyavayi, Ashukari*	Nanoparticle-based rapid bioavailability
Sodhana–Maraṇa	Detoxification & transformation	Green chemistry, biotransformation
Rasayana Effect	*Ojas vardhana, Dhatu poshana*	Antioxidant, anti-aging, regenerative action
Safety Assurance	Proper *saṃskara* ensures non-toxicity	Standardization, ICP-MS validation

CONCLUSION

The results presented show that Rasa Shastra is a scientifically sound, pharmaceutically advanced, and therapeutically successful branch of Ayurveda that goes beyond its historical roots. It treats degenerative and chronic illnesses by improving cellular function and restoring systemic balance through multifaceted and targeted processes. The scientific depth of Ayurvedic pharmacology is further supported by the integration of contemporary nanoscience advancements with classical alchemical approaches.

With appropriate standardization and ethical integration into contemporary medical practice, *Rasa Shastra* formulations possess substantial potential to transform chronic disease management by delivering personalized, sustainable, and holistic healthcare solutions.

Future Perspectives

Standardization, validation, and integration are key to the future of Rasa Shastra in the treatment of chronic illnesses. Using contemporary analytical methods to create pharmaceutically standardized, quality-assured *bhasma* medicines will increase their legitimacy and acceptability in the global healthcare industry. Evidence-based treatments for chronic illnesses including diabetes, osteoarthritis, and neurological diseases can be established through cooperative clinical studies integrating Ayurvedic and biomedical institutions.

Emerging fields like **reverse pharmacology**, **Ayurvedic pharmaco-informatics**, and **Ayur-nanotechnology** can further bridge traditional wisdom with modern science. Ethical regulation, patient safety monitoring, and rigorous documentation are vital for ensuring sustainable integration.

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REFERENCES

1. World Health Organization. Global status report on noncommunicable diseases. Geneva: WHO; 2021.
2. Kumar S, et al. Burden of chronic diseases and role of traditional medicine. *J Ethnopharmacol.*2020;259:112891.
3. Acharya YT, editor. *Charaka Samhita of Agnivesha, Chikitsa Sthana.*Chaukhambha; 2020.
4. Dash V, Kashyap L. *Rasa Shastra: The Science of Indian Alchemy.*Chaukhambha; 2015.
5. Sharma PV. *Rasa Shastra.* Chaukhambha Orientalia; 2019.
6. Patgiri BJ, Prajapati PK. *Fundamentals of Rasa Shastra.* Rashtriya Ayurveda Vidyapeeth; 2016.
7. Singh RH. Exploring issues in the development of Ayurvedic medicine. *J Altern Complement Med.* 2010;16(1):121–123.
8. Acharya JT, editor. *Charaka Samhita, Sutra Sthana.*Chaukhambha; 2020.
9. Krishnamurthy A, et al. Nano-sized metal particles in Ayurvedic Bhasmas: A review. *Evid Based Complement Alternat Med.*2012;2012:245431.
10. Saper RB, Phillips RS, Sehgal A, et al. Heavy metals in Ayurvedic medicines: Safety evaluation. *JAMA.* 2008;300(8):915–923.
11. Rai M, et al. Pharmacological evaluation of Ayurvedic bhasma preparations. *Indian J Exp Biol.* 2016;54(9):573–582.
12. Bhowmik D, et al. Rasa Shastra and its role in the development of nanomedicine. *J Ayurveda Integr Med.* 2018;9(4):243–250.
13. Patwardhan B, Vaidya AD. Natural product drug discovery: reverse pharmacology. *Indian J Exp Biol.* 2010;48(3):220–227.
14. Singh BB, et al. Ayurveda and modern nanomedicine interface. *Springer Integr Med Res.* 2021;10(4):100832.
15. Gogtay NJ, Bhatt HA, Dalvi SS, Kshirsagar NA. The use and safety of non-allopathic Indian medicines. *Drug Saf.* 2002;25(14):1005–1019.

16. Patgiri BJ, Prajapati PK. *Rasa Shastra and chronic disorders – A review of integrative potential.Anc Sci Life.* 2015;34(4):230–236.
17. Acharya YT. *Charaka Samhita of Agnivesha.*Chaukhambha; 2020.
18. Aggarwal BB, Sung B. Chronic diseases and inflammation: molecular basis and clinical relevance. *J Clin Invest.* 2011;121(8):2711-2719.
19. Sharma PV. *Dravyaguna Vijnana.* Vol II. Chaukhambha; 2017.
20. Dash V, Kashyap L. *Rasa Shastra: The Science of Indian Alchemy.*Chaukhambha; 2015.
21. Vagbhata. *Rasa Ratna Samuccaya.* Chaukhambha Orientalia; 2015.
22. Sharma Sadananda. *Rasa Tarangini.* Motilal Banarsidass; 2010.
23. Krishnamurthy A et al. Nano-sized metal particles in Ayurvedic *Bhasmas*: A review. *Evid Based Complement Alternat Med.*2012;2012:245431.
24. Bhowmik D et al. Rasa Shastra and its role in nanomedicine. *J Ayurveda Integr Med.* 2018;9(4):243-250.
25. Prajapati PK, Patgiri BJ. Quality assurance of Ayurvedic metallic preparations. *Anc Sci Life.* 2015;34(3):128-135.
26. Singh RH. *Exploring issues in development of Ayurvedic medicine.J Altern Complement Med.* 2010;16(1):121-123.
27. Patgiri BJ, Prajapati PK. *Fundamentals of Rasa Shastra.* Rashtriya Ayurveda Vidyapeeth; 2016.
28. Sharma V, et al. Synergistic action of *Suvarna Bhasma* with *Guduchi*. *AYU.* 2019;40(2):89-95.
29. Rai M et al. Pharmacological evaluation of *Rasa Sindura*. *Indian J Exp Biol.* 2016;54(9):573-582.
30. Mukherjee PK et al. Chemical characterization of *Abhraka Bhasma*. *J Ethnopharmacol.*2015;159:148-156.
31. Ghosh D et al. Comparative study of *Loha Bhasma* and ferrous sulfate. *Phytother Res.* 2013;27(2):290-295.
32. Patwardhan B, Vaidya AD. Natural product drug discovery: Reverse pharmacology. *Indian J Exp Biol.* 2010;48(3):220-227.
33. Singh BB et al. Clinical evaluation of *Rasa Sindura* in diabetes mellitus. *J Ayurveda Integr Med.* 2018;9(2):95-104.
34. Naik S et al. Immunomodulatory potential of *Suvarna Bhasma*. *J Ethnopharmacol.*2020;246:112214.
35. Tiwari S et al. *Abhraka Bhasma* in neuroprotection: experimental evidence. *Brain Res Bull.*2017;134:151-159.
36. Sharma N et al. *Suvarna Bhasma* in neurodegenerative disorders: A review. *Neurochem Int.*2019;128:85-93.
37. Bhatta A et al. Anti-inflammatory effects of *Yogaraja Guggulu*. *J Ethnopharmacol.*2018;222:56-64.
38. Dash B, Sharma PV. *Materia Medica of Ayurveda.* Vol. II. Chaukhambha; 2016.
39. Singh R et al. Immunostimulant properties of *Suvarna Malini Vasant Rasa.Phytother Res.* 2021;35(8):4448-4458.
40. Gaur D et al. *Tamra Bhasma* in hepatic disorders. *Integr Med Res.* 2019;8(4):256-262.
41. Dutta R et al. Nano-copper in *Tamra Bhasma* and its hepatoprotective role. *Springer Nat Sci.* 2021;13(7):1334-1342.
42. Bhattacharya S. *Concept of Rasayana in Ayurveda.*Chaukhambha; 2018.
43. Naik S et al. Antioxidant properties of *Suvarna Bhasma* and *Abhraka Bhasma*. *J Ayurveda Integr Med.* 2020;11(3):317-326.
44. Mehta R et al. Integrative management of rheumatoid arthritis with *Rasa Sindura*. *J Clin Rheumatol Integr Med.* 2022;15(2):67-75.
45. Sharma A et al. Comparative efficacy of *Loha Bhasma
46. as iron supplement. *Pharm Biol.* 2019;57(1):332-339.
47. WHO. *Safety monitoring of herbal medicines.* Geneva: World Health Organization; 2019.
48. AYUSH Pharmacopoeia Commission. *Standards for Ayurvedic Formulations.* Govt. of India; 2022.
49. Prajapati PK, Patgiri BJ. Safety assurance in *Rasa Shastra.Indian J TraditKnowl.* 2017;16(3):385-394.
50. Patil CR et al. Heavy metal analysis of classical *bhasmas*. *Toxicol Rep.*2020;7:1362-1369.
51. Sharma V et al. Toxicological profiling of *Rasa Sindura*. *Biol Trace Elem Res.* 2021;199(6):2435-2447.
52. Dey S et al. Biochemical effects of *Suvarna Bhasma*. *AYU.* 2018;39(4):219-227.
53. Krishnan M et al. Nanostructural features of *bhasma* formulations. *Adv Nat Sci NanosciNanotechnol.* 2019;10(2):025011.
54. Mitra A et al. Mercury-sulfur nanocomplexes in *Rasa Sindura*. *Sci Rep.*2017;7:10375.