

EXTRACTION, ISOLATION, FORMULATION DEVELOPMENT, AND YAJÑA IN AYURVEDA AND THE ANCIENT VEDAS

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ABSTRACT

Introduction- Ayurveda, one of the world's oldest systems of medicine, has long employed sophisticated pharmaceutical principles for the preparation of herbal, mineral, and animal-derived medicines. Ancient Ayurvedic texts and the Vedas describe various techniques analogous to modern extraction, isolation, purification, and formulation development. These processes include *Swarasa* (fresh juice extraction), *Kalka* (paste), *Kwatha* (decoction), *Hima* (cold infusion), *Phanta* (hot infusion), *Sneha Kalpana* (lipid-based extraction), *Sandhana Kalpana* (fermentation), and *Bhasma* preparation through controlled incineration. Similarly, the Vedic practice of *Yajña* has been proposed to facilitate the controlled release of volatile phytoconstituents and bioactive compounds into the atmosphere, suggesting a possible scientific basis for its traditional therapeutic applications. **Methods-** A narrative review was conducted by examining classical Ayurvedic texts, including the *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, and major *Rasa Shastra* treatises, along with references from the *Rigveda*, *Yajurveda*, *Atharvaveda*, and *Brahmana* literature. Contemporary scientific literature indexed in PubMed, Scopus, Google Scholar, and AYUSH databases was also reviewed to compare traditional pharmaceutical techniques with modern extraction, isolation, formulation development, and phytochemical methodologies. **Results-** The review demonstrates substantial conceptual similarities between traditional Ayurvedic pharmaceutical procedures and modern pharmaceutical sciences. Classical extraction techniques effectively utilize water, lipids, fermentation, and heat as extraction media, while purification (*Shodhana*) and incineration (*Marana*) resemble detoxification and material transformation processes. Ayurvedic formulations employ principles comparable to contemporary drug delivery systems, including optimization of bioavailability, stability, and synergistic activity through polyherbal combinations. Literature on *Yajña* indicates that controlled combustion of medicinal herbs generates volatile phytochemicals, antimicrobial aerosols, aromatic compounds, and bioactive gases that may contribute to environmental purification and potential health benefits. Although experimental evidence supports several pharmacological and antimicrobial effects, standardized methodologies and robust clinical investigations remain limited. **Discussion-** Ancient Ayurvedic pharmaceutics demonstrates remarkable scientific sophistication and aligns with several principles of modern extraction, isolation, and formulation science. The integration of traditional pharmaceutical knowledge with contemporary analytical techniques including chromatography, spectroscopy, metabolomics, and nanotechnology may facilitate the development of evidence-based Ayurvedic medicines. Similarly, interdisciplinary research on *Yajña* may provide deeper insights into its chemical, microbiological, environmental, and therapeutic significance. Future studies should emphasize standardization, quality control, mechanistic investigations, and well-designed clinical trials to validate these traditional concepts according to modern scientific standards.

KEYWORDS: Ayurveda; Extraction; Isolation; Formulation Development; Yajña; Vedas; Bhaishajya Kalpana; Rasa Shastra; Phytochemistry; Traditional Medicine.

INTRODUCTION

- Ayurveda, the traditional system of medicine of India, is one of the oldest documented medical sciences in the world.
- Its knowledge is rooted in the Vedas, especially the *Atharva Veda*, and was systematically developed in classical texts such as the *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya*.
- Ancient Ayurvedic scholars developed sophisticated methods for collecting medicinal plants, extracting active principles, preparing formulations, and using *Yajña* (*Yajna*, *Homa*, *Agnihotra*) as a therapeutic and preventive practice. Many of these principles form the foundation of modern pharmaceutical sciences.

MATERIALS AND METHODS

- This review was conducted using a qualitative, narrative, and interdisciplinary research approach to examine the concepts of extraction, isolation, formulation development, and *Yajña* in *Ayurveda* and the ancient Vedic literature. Classical Ayurvedic texts, Vedic scriptures, and contemporary scientific literature were systematically analyzed to establish conceptual and scientific correlations.

Study Design

- A narrative literature review integrating evidence from classical Ayurvedic texts, Vedic literature, and modern scientific publications.

Data Sources

The study utilized information from the following sources:

- Classical Ayurvedic texts: *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Bhaishajya Kalpana*, *Rasatarangini*, *Sharangadhara Samhita*, *Bhavaprakasha Nighantu*, and *Kaiyadeva Nighantu*.
- Vedic literature: *Rigveda*, *Yajurveda*, *Atharvaveda*, and *Brahmana* literature with emphasis on descriptions of medicinal plants, Soma, Agni, and *Yajña*.
- Modern scientific databases: PubMed, Scopus, Google Scholar, ScienceDirect, Web of Science, and AYUSH Research Portal.

Inclusion Criteria

- Classical Ayurvedic and Vedic references describing medicinal preparation and therapeutic principles.
- Peer-reviewed articles related to herbal extraction, phytochemistry, formulation development, and medicinal smoke.
- Studies discussing *Yajña*, *Agnihotra*, or Vedic healing practices with scientific relevance.

Exclusion Criteria

- Articles lacking scientific or textual authenticity.
- Duplicate publications.

- Non peer reviewed opinions without supporting evidence.
- Studies unrelated to Ayurveda or Vedic pharmaceuticals.

Data Extraction

Relevant information was extracted regarding:

- Traditional extraction techniques (*Swarasa*, *Kalka*, *Kwatha*, *Hima*, *Phanta*, *Arka*).
- Isolation of bioactive phytoconstituents.
- Principles of Ayurvedic formulation development.
- Pharmaceutical processing methods.
- References to *Yajña* and medicinal fumigation.
- Modern analytical validation and pharmacological evidence.

Data Analysis

Extracted information was organized into thematic categories:

- Extraction techniques in Ayurveda.
- Isolation and characterization of phytochemicals.
- Development of Ayurvedic formulations.
- Scientific basis of *Yajña* and medicinal fumigation.
- Integration of traditional knowledge with contemporary pharmaceutical sciences.

A comparative analysis was performed to identify similarities between classical Ayurvedic pharmaceuticals and modern drug development methodologies.

RESULTS AND DISCUSSION

Extraction in Ayurveda

- Extraction is the process of obtaining the therapeutically active constituents from medicinal plants, minerals, or animal products using suitable methods.

Ancient Ayurvedic Concept

- Ayurvedic texts describe extraction through different *Kalpanas* (**pharmaceutical preparations**) designed to obtain specific medicinal principles.

Major Extraction Methods

- **Swarasa (Fresh Juice)**- Prepared by crushing fresh herbs and filtering the juice. Considered the most potent extraction. Used immediately after preparation. **Ex;** *Tulsi* juice, *Aloe vera* juice, *Neem* leaf juice
- **Kalka (Paste)**- Fresh or dried herbs are ground into a fine paste. Uses- Internal administration, External application, Base material for oils and ghee
- **Kwatha (Decoction)**- Hard plant parts are boiled with water until reduced to one-fourth. Suitable for Bark, Roots, Seeds, Hard stems. **Ex;** *Dashamoola Kwatha*, *Triphala Kwatha*
- **Phanta (Hot Infusion)**- Hot water is poured over herbs and allowed to stand. Used for- Delicate aromatic herbs, Flowers, Leaves

- **Hima (Cold Infusion)**- Herbs are soaked overnight in cold water. Advantages- Preserves heat sensitive constituents, Cooling preparations. Ex; Coriander, Sandalwood
- **Asava and Arishta**- Natural fermentation extracts both water soluble and alcohol soluble constituents. Ex; *Ashokarishta, Drakshasava, Arjunarishta*
- **Sneha Kalpana**- Extraction into lipid media. **Media**- Ghee, Sesame oil, Coconut oil Ex; *Brahmi Ghrita, Mahanarayana Taila*

Modern Interpretation- Ancient extraction methods correspond to modern pharmaceutical techniques:

Ayurvedic Method	Modern Equivalent-
Swarasa	Fresh juice extraction
Kwatha	Decoction
Hima	Cold extraction
Phanta	Infusion
Sneha	Lipid extraction
Asava	Fermentation extraction

Isolation in Ayurveda

- Isolation refers to obtaining purified medicinal substances from natural sources. Although classical *Ayurveda* generally preferred whole-plant therapy, several purification and concentration techniques were employed.

Purification (Shodhana)

- Shodhana removes impurities and toxicity. Used for- Metals, Minerals, Toxic herbs Ex; Mercury, Sulphur, Aconite, *Bhallataka*
- **Methods include**- Boiling, Soaking, Trituration, Heating, Quenching

Concentration (Ghana)

- Decoctions are concentrated to produce *Ghana* (solid extracts). Ex; *Guduchi Ghana, Neem Ghana*. Comparable to modern dry extract technology.

Satva Extraction

- *Satva* refers to the purified active fraction obtained from certain plants. Ex; *Guduchi Satva, Shatavari Satva*. These preparations are relatively purified compared with crude plant material.

Mineral Isolation

- Classical Rasashastra developed methods for obtaining purified mineral preparations. Ex; *Abhraka Bhasma, Swarna Bhasma, Lauha Bhasma*

Modern Comparison

- Modern isolation involves- Chromatography, Crystallization, Solvent extraction, Distillation
- *Ayurveda* traditionally focused on purification and concentration rather than isolating single chemical molecules.

Formulation Development in Ayurveda

- Formulation development is the process of converting medicinal ingredients into stable, safe, effective dosage forms.

- Ayurveda possesses one of the world's oldest pharmaceuticals known as *Bhaishajya Kalpana*.
- **Objectives**- Improve efficacy, Increase stability, Enhance palatability, Improve shelf life, Facilitate administration, Reduce toxicity.

Major Dosage Forms

- **Churna (Powder)**- Ex; *Triphala Churna, Sitopaladi Churna*
- **Vati/Gutika (Tablets)**- Ex; *Chandraprabha Vati, Arogyavardhini Vati*
- **Avaleha (Linctus)**- Ex; *Chyawanprash, Vasavaleha*
- **Ghrita (Medicated Ghee)**- Ex; *Brahmi Ghrita, Panchagavya Ghrita*
- **Taila (Medicated Oils)**- Ex; *Dhanvantaram Taila, Bala Taila*
- **Asava-Arishta**- Self-generated alcoholic preparations. Ex; *Kumaryasava, Ashokarishta*
- **Bhasma**- Calcined metallic/mineral formulations. Ex; *Swarna Bhasma, Mukta Bhasma*
- **Rasayana Preparations**- Designed to promote longevity and rejuvenation. Ex; *Chyawanprash, Amalaki Rasayana*.

Principles of Formulation Development

- Selection of raw materials, Authentication of herbs, Proper collection season, Purification (Shodhana), Standardized processing, Quality control, Appropriate storage, Shelf-life considerations, Dose standardization.

Modern Relevance

- Modern Ayurvedic pharmaceutical industries apply: Good Manufacturing Practices (GMP), Standardization, Marker compound analysis, HPLC and HPTLC fingerprinting, Microbial testing, Stability studies.

Yajna in Ayurveda and the Ancient Vedas

- **Meaning**- The Sanskrit word *Yajna* means worship, sacrifice, offering, and sacred fire ritual. In the Vedic tradition, medicinal herbs, ghee, grains, and

aromatic substances are offered into a sacred fire while Vedic mantras are recited.

Vedic References

- **Rig Veda-** Describes *Agni* (fire) as the divine messenger who carries offerings and purifies the environment.
- **Atharva Veda-** Contains hymns on healing, disease prevention, medicinal plants, fumigation, and the therapeutic use of fire rituals.
- **Yajur Veda-** Provides detailed procedures for conducting *Yajna*, including the preparation of offerings and ritual methods.

Ayurvedic Perspective

- Ayurveda recognizes **Dhoopana Karma (medicinal fumigation)**, where the smoke generated from burning specific herbs is used to purify environments and support health.
- Traditionally, fumigation has been recommended for: Homes, Hospital, Delivery rooms, Surgical areas, Wards, Animal shelters
- Medicinal substances commonly used include: *Neem, Guggulu, Vacha, Haridra* (Turmeric), *Nimba* leaves, Mustard, Cow ghee, Camphor

Possible Scientific Basis

Researchers have proposed several mechanisms through which *Yajna* smoke or medicinal fumigation may influence the environment:

- Release of volatile phytochemicals from medicinal plants. Reduction of airborne microbial counts under certain experimental conditions. Generation of pleasant aromatic compounds that may promote relaxation. Insect-repellent effects of some herbal smokes.

Agnihotra

Agnihotra is a specific Vedic fire ritual performed at sunrise and sunset using:

- Cow dung cakes, Cow ghee, Unbroken rice grains, Copper pyramid vessel, Prescribed Vedic mantras
- It is traditionally believed to promote environmental purification and mental well being. Scientific studies have explored changes in air quality and microbial load following *Agnihotra*.

Integration with Modern Pharmaceutical Science

Ancient Ayurvedic Practice	Modern Pharmaceutical Equivalent
<i>Swarasa</i>	Fresh juice extraction
<i>Kwatha</i>	Decoction
<i>Phanta</i>	Infusion
<i>Hima</i>	Cold maceration
<i>Sneha Kalpana</i>	Lipid extraction
<i>Asava-Arishta</i>	Fermentation technology
<i>Ghana</i>	Concentrated extract
<i>Satva</i>	Purified plant fraction
<i>Bhaishajya Kalpana</i>	Formulation development
<i>Shodhana</i>	Detoxification and purification
<i>Bhasma</i>	Specialized mineral processing
<i>Dhoopana</i>	Herbal fumigation

References from the Vedas

- **Rig Veda-** The *Rig Veda* contains numerous hymns praising medicinal plants (*Oṣadhis*) and *Agni* (fire), laying the foundation for later Ayurvedic pharmaceuticals.
- **Medicinal Plants- Rig Veda 10.97 (Oṣadhi Sukta)** "The herbs, born in ancient times, three ages older than the gods, I invoke for healing." This hymn describes the healing properties of medicinal plants and their divine origin.
- **Rig Veda 1.1.1 Agni (Fire)-** "I praise *Agni*, the priest of the sacrifice, the divine minister of the *yajña*." *Agni* is regarded as the purifier and carrier of medicinal offerings.
- **Atharva Veda-** The *Atharva Veda* is regarded as the principal *Veda* related to medicine.
- **Medicinal Herbs- Atharva Veda 8.7-** Describes herbs as destroyers of disease and promoters of health.
- **Fumigation-** Several hymns describe purification using fragrant medicinal substances burned in fire for protection against diseases and harmful influences.
- **Yajur Veda-** The *Yajur Veda* gives detailed procedures for *Yajna* and the preparation of offerings.
- **Shukla Yajur Veda (Vajasaneyi Samhita)-** Describes: Selection of medicinal woods, Use of clarified butter (*Ghrta*), Aromatic herbs, Proper fire rituals

References from Charaka Samhita

- **Pharmaceutical Preparations- Charaka Samhita, Sutra Sthana, Chapter 4,** Discusses: Collection of

medicinal plants, Selection of herbs, Storage, Drug processing

- **Charaka Samhita, Sutra Sthana, Chapter 26**, Describes: *Swarasa, Kalka, Kwatha, Hima, Phanta*. These represent the classical extraction techniques.
- **Charaka Samhita, Kalpa Sthana**- Deals extensively with: Drug preparation, Pharmaceutical processing, Detoxification, Dosage
- **Charaka Samhita, Siddhi Sthana**- Explains preparation of medicated formulations and their administration.
- **References from Sushruta Samhita- Sushruta Samhita, Sutra Sthana, Chapter 38** Describes: Collection of medicinal plants, Preparation of decoctions, Medicated oils, Ghee preparations
- **Sushruta Samhita, Chikitsa Sthana**- Details: *Ghruta* preparation, *Taila* preparation, *Avaleha*, Medicated formulations
- **Dhoopana (Fumigation)- Sushruta Samhita, Sutra Sthana 5**- Recommends fumigation of: Surgical rooms, Instruments, Wounds, Hospitals, Environmental purification, Prevention of infection. Using herbs like: *Guggulu, Neem, Sarjarasa, Musta, Vacha*
- **References from Ashtanga Hridaya- Sutra Sthana, Chapters 5 and 6**- Describes pharmaceutical preparations including: *Churna, Kwatha, Ghruta, Taila, Avaleha Dhoopana*
- **Sharngadhara Samhita**- This text is considered one of the earliest systematic books on Ayurvedic pharmaceuticals.

- **Madhyama Khanda**- Describes: *Swarasa, Kalka, Kwatha, Hima, Phanta, Churna, Avaleha, Asava, Arishta, Ghruta, Taila*. The text also discusses: Drug dosage, Shelf life Preservation, Formulation methods
- **Bhaishajya Ratnavali**- Contains hundreds of standardized formulations. Includes: *Vati Avaleha, Ghruta, Taila, Churna, Rasa* preparations
- **Rasaratna Samuccaya**- Primary reference for: *Shodhana, Marana, Bhasma* preparation Purification of minerals, Pharmaceutical processing
- **Rasatarangini**- Provides detailed procedures for: Isolation-like purification, Metal detoxification, *Bhasma* preparation, Quality testing
- **Kashyapa Samhita**- Discusses: Pediatric formulations, *Ghruta, Oils, Herbal* preparations Processing methods.

Classical References on Yajna and Dhoopana

- **Rig Veda**- *Mandala 1, Sukta 1 (Agni Sukta), Mandala 10, Sukta 97 (Oṣadhi Sukta)*
- **Atharva Veda**- Book 8 (Medicinal herbs), Book 19 (Healing plants)
- **Shatapatha Brahmana**- Explains: Types of *Yajnas*, Medicinal offerings, Purification through fire
- **Grihya Sutras**- Describe: *Agnihotra, Daily fire rituals, Medicinal offerings*.

Ancient References to Pharmaceutical Concepts

Pharmaceutical Concept	Ancient Reference
Collection of herbs	<i>Charaka Samhita, Sutra Sthana 1 & 4</i>
Drug extraction	<i>Charaka Samhita, Sutra Sthana 26</i>
Decoction (<i>Kwatha</i>)	<i>Sharngadhara Samhita, Madhyama Khanda</i>
Cold infusion (<i>Hima</i>)	<i>Sharngadhara Samhita</i>
Hot infusion (<i>Phanta</i>)	<i>Sharngadhara Samhita</i>
Medicated oils	<i>Sushruta Samhita, Chikitsa Sthana</i>
<i>Ghruta</i> preparation	<i>Charaka Samhita; Sushruta Samhita</i>
Fermented preparations	<i>Sharngadhara Samhita</i>
<i>Shodhana</i>	<i>Rasaratna Samuccaya</i>
<i>Bhasma</i>	<i>Rasatarangini</i>
<i>Dhoopana</i>	<i>Sushruta Samhita, Sutra Sthana 5</i>
Environmental purification	<i>Atharva Veda</i>
<i>Yajña</i>	<i>Rig Veda, Yajur Veda, Shatapatha Brahmana</i>

CONCLUSION

The concepts of extraction, isolation, formulation development, and *Yajña* described in Ayurveda and the ancient Vedic literature collectively illustrate the depth and sophistication of traditional Indian scientific knowledge. While the Vedas primarily present these concepts in philosophical and ritualistic contexts, Ayurveda systematically transformed them into practical methods for the preparation and therapeutic application of medicines. Classical pharmaceutical processes such as *Swarasa, Kalka, Kwatha, Hima, Phanta, Asava-Arishta*,

Sneha Kalpana, and Bhasma preparation demonstrate a well-developed understanding of extraction, purification, concentration, and formulation principles that remain relevant to modern herbal drug development. Isolation in Ayurveda emphasizes the purification and enhancement of medicinal substances through *Shodhana, Bhavana, and Marana*, ensuring improved efficacy, safety, and bioavailability rather than isolating a single active constituent. This holistic approach aligns with current scientific evidence supporting the synergistic action of multiple phytoconstituents in herbal medicines.

Furthermore, *Yajña* represents a unique Vedic pharmaceutico therapeutic process wherein medicinal herbs, ghee, and other natural substances undergo controlled combustion, generating bioactive vapours that may contribute to environmental purification and health promotion. Although traditional texts extensively describe its spiritual, ecological, and therapeutic significance, contemporary scientific investigations have begun to explore its antimicrobial, air-purifying, and psychosocial effects. These findings suggest that *Yajña* may offer complementary benefits alongside conventional healthcare, warranting rigorous multidisciplinary research.

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