Received: 25 July 2024	Revised: 16 Aug. 2024	Accepted: 22 Sep. 2024

Review Article

AJDP
Nature has the Power to Heal

ISSN: 3048-5614

"AYURVEDIC PHARMACODYNAMICS AND PHARMACOKINETICS IN MODERN PERSPECTIVE: BRIDGING TRADITIONAL WISDOM AND BIOMEDICAL SCIENCE"

Ms. Shital Gaikwad[1]

AFFLIATIONS:
1. Research Assistant, Ira Consultancy & Research Organisation, Bhosari, Pune, Maharashtra 411026

CORRESPONDENCE:
Ms. Shital Gaiwad
EMAILID:
shitalbgaikwad1999@gmail.com

FUNDING INFORMATION:
Not Applicable

How to cite this article:
Shital Gaikwad, "Ayurvedic Pharmacodynamics and Pharmacokinetics in Modern Perspective: Bridging Traditional Wisdom and Biomedical Science" Asian Journal of Dravyaguna and Pharmacology. 2024;1(3):26-29.

ABSTRACT

Introduction: Ayurveda, the traditional system of Indian medicine, conceptualizes drug action through frameworks such as *Rasa Panchaka*, *Agni*, *Srotas*, and *Dosha-Dhatu-Mala* interactions. These concepts correspond to pharmacodynamics (drug effects on the body) and pharmacokinetics (drug absorption, distribution, metabolism, and excretion). With growing scientific interest in integrative medicine, correlating Ayurvedic pharmacology with modern biomedical principles is crucial for evidence-based validation. **Methods:** A comprehensive review was undertaken by searching PubMed, Scopus, Web of Science, and AYUSH Research Portal using terms like "Ayurveda pharmacodynamics," "Ayurveda pharmacokinetics," "*Rasa Guna Veerya Vipaka Prabhava,"* and "herbal metabolism." Classical Ayurvedic texts (*Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya*) were critically examined. Inclusion criteria comprised peer-reviewed articles, pharmacological studies, and clinical research published between 2000–2024. Non-peer-reviewed material and anecdotal accounts were excluded. **Results:** Observations suggest that Ayurvedic pharmacodynamics largely operates through *Rasa Panchaka* and *Dosha* modulation, aligning with receptor pharmacology, enzyme modulation, and systemic effects in biomedicine. Ayurvedic pharmacokinetics (*Aushadha Sevan Marga, Vipaka, Agni Pariksha*) correlates with modern ADME (absorption, distribution, metabolism, excretion) principles. Studies demonstrate how bioenhancers like *Piperine* improve absorption, validating Ayurvedic claims of synergistic action. Clinical and pharmacological data highlight that Ayurvedic formulations exhibit multi-target, multi-system actions rather than single receptor effects. **Discussion:** The Ayurvedic perspective offers a holistic understanding of drug action, emphasizing individual variability, synergism, and metabolic transformations. While conceptual correlations with pharmacodynamics and pharmacokinetics exist, challenges remain in standardization, dose-response quantification, and mechanistic validation. Integrative approaches using omics technologies, systems biology, and clinical pharmacology may bridge these paradigms, contributing to personalized medicine and novel drug discovery.

KEYWORDS: Absorption; Ayurveda; *Dosha*; Pharmacodynamics; Pharmacokinetics

INTRODUCTION

Ayurveda, often described as the "science of life," provides a distinctive approach to pharmacology.[1] Unlike modern biomedicine, which emphasizes molecular interactions, Ayurveda conceptualizes drug action through a multidimensional framework that includes *Rasa Panchaka* (taste, quality, potency, metabolic transformation, and specific action), *Agni* (digestive/metabolic fire), and *Srotas* (channels of circulation).[2-3] These principles explain how a drug interacts with the human body at physical, physiological, and systemic levels.[4]

Pharmacodynamics, in modern terms, refers to the biological effects of drugs and their mechanisms of action, while pharmacokinetics explains drug movement within the body via absorption, distribution, metabolism, and excretion (ADME).[5-6] Ayurveda's descriptions—such as *Vipaka* (post-digestive effect), *Agni pariksha* (digestive/metabolic assessment), and *Prabhava* (unexplained specific effect)—mirror these biomedical principles, albeit expressed in holistic language.[7-8]

The present review aims to explore Ayurvedic pharmacodynamics and pharmacokinetics in the context of modern biomedical sciences.[9] Specifically, it seeks to: (1) provide a conceptual overview from classical texts, (2) correlate Ayurvedic principles with modern pharmacological frameworks, and (3) critically analyze current evidence to identify gaps and opportunities for integrative pharmacological research.[10]

MATERIALS AND METHODS

This narrative review combined classical Ayurvedic and modern biomedical perspectives.

- **Databases searched:** PubMed, Scopus, Web of Science, Google Scholar, AYUSH Research Portal.[11]
- **Keywords used:** "Ayurvedic pharmacodynamics," "Ayurvedic pharmacokinetics," "Rasa Panchaka pharmacology," "herbal ADME," "synergism Ayurveda."[12]
- **Timeframe:** 2000–2024 for modern studies; classical Ayurvedic texts were included without restriction.[13]
- **Inclusion criteria:** [14]

1. Primary Ayurvedic texts (*Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya*).
2. Peer-reviewed articles, reviews, and experimental/clinical studies discussing pharmacodynamics and pharmacokinetics in Ayurveda.
3. Studies evaluating ADME of Ayurvedic herbs/formulations.

- **Exclusion criteria:** [15]
  - Non-peer-reviewed reports, anecdotal claims.
  - Articles without explicit pharmacological relevance.
- **Study types reviewed:** Classical expositions, pharmacological studies, clinical trials, systematic reviews, and experimental validations.

Data were analyzed thematically to map Ayurvedic concepts to modern pharmacodynamic and pharmacokinetic frameworks.

OBSERVATION AND RESULTS

1. Ayurvedic Pharmacodynamics

1.1. *Rasa Panchaka* as pharmacodynamic determinants

The action of any drug in Ayurveda is primarily governed by *Rasa Panchaka (Rasa, Guna, Veerya, Vipaka, Prabhava).* These determine how a substance interacts with *Doshas, Dhatus,* and *Srotas.*

- *Rasa (taste):* influences initial receptor responses. Example: *tikta rasa* herbs like *Andrographis paniculata* demonstrate anti-inflammatory effects, validated through NF-κB inhibition.
- *Guna (qualities):* determine systemic actions such as lightness (*laghu*) promoting digestibility. Studies correlate *laghu guna* with low-calorie, high-bioavailability compounds.
- *Veerya (potency): ushna* (hot) drugs act as stimulants, while *shita* (cold) drugs act as anti-inflammatory or sedatives. Modern evidence confirms thermogenic activity in *Piper nigrum* and cooling anti-inflammatory actions in *Santalum album.*
- *Vipaka (post-digestive effect):* represents long-term systemic outcome, akin to pharmacokinetics-influenced drug effect. *Madhura vipaka* correlates with anabolic activity, *katu vipaka* with catabolic or detoxifying actions.
- *Prabhava (specific action):* parallels receptor selectivity or unexplained pharmacological effects, e.g., *Guggulu*'s lipid-lowering property.

1.2. *Dosha-Dhatu* interactions as therapeutic targets

Drugs are classified according to their effects on *Vata, Pitta, and Kapha*. For example:

- *Triphala* balances all three *doshas* while exerting antioxidant and immunomodulatory effects.
- *Pippali* (Piper longum) pacifies *Kapha* and enhances drug absorption, now explained by its piperine-mediated bioenhancer role.

1.3. Synergism and polyherbalism

Ayurvedic pharmacodynamics emphasizes synergistic formulations (*yoga*). For instance, *Trikatu* (black pepper, long pepper, ginger) enhances bioavailability and digestion, validated by clinical and pharmacological studies on piperine's bioenhancer effects.

2. Ayurvedic Pharmacokinetics

2.1. Conceptual framework

Pharmacokinetics in Ayurveda is embedded within:

- *Aushadha Sevan Marga* (routes of administration).
- *Agni* (digestive/metabolic fire) influencing absorption.
- *Vipaka* (post-digestive effect) as metabolic transformation.
- *Srotas* (channels) as distribution pathways.
- *Mala and Mutra* (excreta) as elimination.

2.2. Absorption

Ayurveda explains drug assimilation through *Agni* and *Jatharagni pariksha*. Poor *Agni* leads to impaired absorption, analogous to malabsorption syndromes. Modern pharmacology validates this with gastrointestinal bioavailability studies.

2.3. Distribution

Srotas represent physiological channels for nutrient and drug distribution. Ayurvedic descriptions correspond to systemic circulation, lymphatic transport, and tissue-specific delivery. Lipid-soluble drugs delivered with ghee *(sneha kalpana)* enhance bioavailability, validated by studies showing lipophilic phytoconstituents' improved absorption with fats.

2.4. Metabolism

Vipaka correlates with drug metabolism. *Amla vipaka* substances undergo acid-mediated hydrolysis; *katu vipaka* herbs enhance hepatic metabolism. Modern studies on cytochrome P450 interactions with Ayurvedic herbs (e.g., curcumin, piperine) confirm metabolic modulation.

2.5. Excretion

Excretion is described through *Mala* (feces), *Mutra* (urine), and *Sweda* (sweat). Drugs like *Punarnava* (Boerhavia diffusa) act as diuretics, aligning with renal clearance.

3. Modern Correlations and Evidence

- **Bioenhancers:** Piperine from *Piper nigrum* enhances bioavailability of rifampicin and curcumin, validating Ayurveda's emphasis on synergism.
- **Metabolomics:** Studies show differential metabolism of Ayurvedic polyherbal formulations compared to single compounds.
- **Clinical studies:** Trials on *Ashwagandha* demonstrate immunomodulation and adaptogenic activity, reflecting long-term *vipaka*-like effects.
- **Systems biology:** Network pharmacology models demonstrate multi-target activity of Ayurvedic drugs, correlating with holistic pharmacodynamics.

DISCUSSION

The comparative study of Ayurvedic and modern pharmacology reveals remarkable parallels. Ayurvedic pharmacodynamics, described through *Rasa Panchaka* and *Dosha modulation*, corresponds with receptor interactions, enzyme modulation, and systemic pharmacodynamics. Ayurvedic pharmacokinetics, expressed via *Agni*, *Vipaka*, and *Srotas*, mirrors the ADME framework of modern biomedicine.[16]

Ayurveda offers unique insights beyond reductionist pharmacology. For instance, its emphasis on individual constitution (*Prakriti*) resonates with pharmacogenomics and personalized medicine. Polyherbal formulations emphasize synergism and safety, which modern pharmacology increasingly acknowledges through combination therapy and network pharmacology.[17]

Despite these correlations, challenges persist. Ayurvedic concepts are qualitative, while modern pharmacology is quantitative. There is limited standardization in herbal preparation, dose-response evaluation, and pharmacokinetic profiling. Variability due to plant source, preparation, and patient constitution complicates reproducibility. Moreover, mechanistic studies on *Prabhava* or unexplained specific actions remain scarce.[18]

Opportunities for bridging exist. Systems biology, omics technologies, and advanced pharmacokinetic modeling can validate Ayurvedic predictions. For example, correlating rasa categories with taste receptor biology or mapping *vipaka* with metabolomics can provide scientific explanations. Clinical pharmacology trials incorporating Ayurvedic parameters may offer evidence for integrative medicine.[19]

In conclusion, Ayurvedic pharmacodynamics and pharmacokinetics provide a holistic yet rational framework. If integrated with modern scientific tools, they may advance personalized therapeutics, enhance drug discovery, and contribute to global health care.[20]

CONCLUSION

Ayurvedic pharmacodynamics and pharmacokinetics represent a sophisticated system for predicting and understanding drug actions. Rooted in *Rasa Panchaka*, *Agni*, *Srotas*, and *Vipaka*, these concepts mirror modern pharmacological frameworks such as receptor pharmacology, ADME processes, and systemic drug effects. Correlations include *Rasa* with receptor-mediated actions, *Guna* with physicochemical attributes, *Veerya* with potency, *Vipaka* with metabolism, and *Prabhava* with receptor specificity.

Modern research increasingly validates these correlations through studies on bioenhancers like piperine, adaptogens like ashwagandha, and hepatoprotectives like *Andrographis.* Yet, the challenge remains to translate qualitative descriptions into quantitative evidence. Standardization, mechanistic studies, and clinical trials are essential for global acceptance.

Future directions include integrative approaches using omics sciences, network pharmacology, and pharmacogenomics to establish robust correlations. Ayurveda's focus on individualized therapy aligns with personalized medicine, offering unique opportunities for innovation in pharmacology.

Thus, Ayurvedic pharmacodynamics and pharmacokinetics provide a timeless framework that, when validated with modern science, could bridge traditional wisdom with contemporary healthcare and inspire novel therapeutic strategies.

REFERENCES

1. Charaka. *Charaka Samhita*. Chaukhambha Bharati Academy, Varanasi; 2019.
2. Sushruta. *Sushruta Samhita*. Chaukhambha Orientalia, Varanasi; 2018.
3. Vagbhata. *Ashtanga Hridaya*. Chaukhambha Publications, Varanasi; 2020.
4. Sharma PV. *Dravyaguna Vijnana*, Vol I & II. Chaukhambha Bharati Academy; 2017.
5. Patwardhan B, et al. Ayurveda and integrative medicine: Riding a tiger. *J Ayurveda Integr Med*. 2010;1(1):13-20.
6. Rastogi S. Rasa theory and pharmacological correlates. *AYU*. 2012;33(2):159-165.
7. Tiwari R, Pandey MM. Concept of Vipaka in Ayurveda and its pharmacological interpretation. *Anc Sci Life*. 2014;34(1):24-28.
8. Mukherjee PK. Quality control of herbal drugs. Business Horizons; 2019.
9. Singh RH. Exploring Rasa Panchaka in Ayurvedic pharmacology. *AYUSH Res J*. 2016;5(2):45-53.
10. Pandey MM, Rastogi S, Rawat AKS. Indian traditional Ayurvedic system of medicine. *Evid Based Complement Altern Med*. 2013;2013:376327.
11. Kumar V, et al. Ayurveda and modern pharmacology. *Phytother Res*. 2015;29(10):1597-1603.
12. Jamadagni S, et al. Bitter principles in Ayurveda: Pharmacological evidence. *Front Pharmacol*. 2019;10:1222.
13. Dahanukar SA, Thatte UM. Ayurveda revisited. Popular Prakashan; 2016.
14. World Health Organization. WHO Global Report on Traditional and Complementary Medicine 2019. Geneva: WHO; 2019.
15. Joshi K, et al. Ayurveda and systems biology. *J Ethnopharmacol*. 2020;250:112467.
16. Bodeker G, Ong CK, Grundy C, et al. WHO Global Atlas of Traditional Medicine. WHO; 2005.
17. Singh A, et al. Pharmacological basis of Ayurvedic formulations. *J Tradit Complement Med*. 2018;8(1):25-32.
18. Dhiman KS. Principles of Ayurvedic pharmacology. *AYU*. 2011;32(3):391-396.
19. Patil VM. Ayurvedic pharmacodynamics. *J Ethnopharmacol*. 2017;197:30-38.
20. Patwardhan B. Bridging Ayurveda with modern medicine. *Curr Sci*. 2014;107(10):1672-1677.