INTERNATIONAL RESEARCH JOURNAL OF HUMANITIES AND INTERDISCIPLINARY STUDIES
(Peer-reviewed, Refereed, Indexed & Open Access Journal)
DOI : 03.2021-11278686 ISSN : 2582-8568 IMPACT FACTOR : 8.428 (SJIF 2026)

Contemporary Review: Dravya-Guna-Karma of Plant-Origin Drugs and Their Alignment with Modern Pharmacognosy

Dr. Chaudhary T. Y.[1], Dr. Pawar P. S.[2], Dr. Pawale P. S.[3], Dr. Dani V. B.[4], Dr. Patil S. V.[5]

[1]PG Sch., Shri Saptashrungi Ayurveda College, Nashik (Maharashtra, India)

[2]HOD, Professor, Shri Saptashrungi Ayurveda College, Nashik (Maharashtra, India)

[3]Professor, Shri Saptashrungi Ayurveda College, Nashik (Maharashtra, India)

[4]Associate Professor, Shri Saptashrungi Ayurveda College, Nashik (Maharashtra, India)

[5]Assistant Professor, Shri Saptashrungi Ayurveda College, Nashik (Maharashtra, India)

DOI No. 03.2021-11278686 **DOI Link ::** https://doi-ds.org/doilink/09.2026-51353998/IRJHIS2609003

Abstract:

The foundational framework of Ayurvedic pharmacology—Dravya (substance), Guna (pharmacological properties/attributes), and Karma (pharmacodynamic action)—presents a multi-targeted, systems-biology model for therapeutic interventions. While classical Ayurveda interprets botanical activities through energetic paradigms such as Rasa (taste), Virya (potency), Vipaka (post-digestive transformation), and Prabhava (specific efficacy), contemporary phytopharmacology rationalizes these actions via secondary metabolites, specific molecular targets, and signaling pathways. This review evaluates the conceptual overlap between traditional Dravya-Guna-Karma principles and modern pharmacological mechanisms, illustrating how ancient botanical principles align with current phytomedicine.

Keywords: *Dravya, Guna, Karma, phytopharmacology, phytomedicine*

Introduction & Theoretical Framework:

In Ayurvedic pharmacology, a botanical drug (*Dravya*) is evaluated not as an isolated active compound, but as a complex matrix whose net clinical outcome (*Karma*) stems from its inherent functional qualities (*Guna*). The classical doctrine defines this relationship through a functional progression:

Dravya - (Rasa, Guna, Virya, Vipaka) - Karma

Mapped to modern phytopharmacology, this continuum corresponds to:

- **Dravya:** Whole botanical raw materials containing synergistic phytochemical profiles (alkaloids, flavonoids, saponins, and terpenoids).
- **Guna & Rasa:** Physicochemical attributes and organoleptic properties that influence solubility,

mucosal absorption, and early gustatory signaling.

- **Virya & Vipaka:** Biotransformation (pharmacokinetics) and active pharmacodynamic responses within target tissues.
- **Karma:** Net physiological and therapeutic outcomes (e.g., immunomodulation, anti-inflammatory action, neuroprotection).

Comparative Analysis of Foundational Principles

Ayurvedic Framework	Modern Pharmacological Correlate
Rasa (Taste/Organoleptic)	Gustatory G-Protein - Coupled Receptors (GPCR)
Guna (Qualities/Density)	Molecular Weight - Permeability, Lipophilicity
Virya & Vipaka	Metabolic Rate, Gut - (Potency/Post-Digestive) Microbiome Metabolism
Prabhava (Specific)	Targeted Key-Lock - Receptor Affinity

Rasa & Guna vs. Molecular Receptor Signaling:

Ayurvedic texts categorize *Rasa* into six distinct taste profiles (Bitter, Pungent, Astringent, Sweet, Sour, and Salty). Modern gastrointestinal physiology confirms that taste receptors (such as TAS2Rs for bitter taste and TRP channels for pungency) are functional throughout the human digestive tract. Activation of bitter receptors (*Tikta Rasa*) stimulates gastrointestinal peptides like GLP-1 and CCK, driving digestive enzyme secretion—a mechanism directly parallel to the classical *Deepana-Pachana* (digestive-carminative) *Karma*.

Similarly, *Guna* classifications like *Laghu* (light/easily assimilated) or *Guru* (heavy/slowly digested) align with physical chemistry parameters such as molecular weight, lipid solubility, and intestinal transit rates.

Virya & Vipaka vs. Metabolism & Pharmacokinetics:

- *Ushna Virya* (heating potency) corresponds to compounds that induce peripheral vasodilation, elevate metabolic expenditure, and stimulate thermogenesis (e.g., piperine, capsaicinoids).
- *Sheeta Virya* (cooling potency) corresponds to agents exhibiting anti-pyretic, cell-membrane stabilizing, and anti-inflammatory properties.
- *Vipaka* reflects post-digestive metabolic changes driven by hepatic biotransformation and gut microflora, converting parent phytochemicals into active metabolic derivatives.

Comparative Case Studies: Phytochemical & Pharmacological Mapping:

The interplay between *Dravya-Guna-Karma* and modern pharmacodynamics is demonstrated across key botanical models:

Botanical Name / Classical Dravya	**Classical Attributes (*Rasa, Guna, Virya, Vipaka*)**	**Classical *Karma***	**Key Phytochemicals**	**Modern Pharmacological Mechanism**
Curcuma longa *(Haridra)*	*Tikta, Katu*(Bitter, Pungent) *Ruksha, Laghu*(Dry, Light) *Ushna* (Heating) *Katu Vipaka*	*Vrana Ropana*(Tissue healing) *Kaphahara* *Sothahara*(Anti-inflammatory)	Polyphenols (Curcuminoids), Sesquiterpenes (Turmerones)	Down-regulation of NF-κB transcription, inhibition of COX-2 and iNOS pathways, reduction of pro-inflammatory cytokines (TNF-α, IL-6).
Withania somnifera *(Ashwagandha)*	*Tikta, Kashaya* (Bitter, Astringent) *Laghu, Snigdha*(Light, Unctuous) *Ushna* (Heating) *Madhura Vipaka*	*Rasayana*(Adaptogenic) *Balya* (Strength-promoting) *Vatashamana*(Anxiolytic)	Steroidal lactones (Withanolides, Withaferin A), Alkaloids	Modulation of GABA-A receptors, attenuation of HPA-axis stress response, elevation of endogenous antioxidant enzymes (SOD, catalase).
Tinospora cordifolia *(Guduchi)*	*Tikta, Kashaya*(Bitter, Astringent) *Laghu, Snigdha*(Light, Unctuous) *Ushna* (Heating) *Madhura Vipaka*	*Rasayana*(Adaptogenic) *Jwarahara*(Anti-pyretic) *Vayasthapana*(Anti-aging)	Diterpene furanosides (Cordifolioside A), Alkaloids (Magnoflorine)	Stimulation of macrophages via TLR4 pathways, enhancement of neutrophil phagocytic activity, balanced cytokine production.

Modern Perspectives & Synergistic Medicine:

A primary strength of Ayurvedic pharmacotherapy lies in **Synergy (*Yukti*)** through whole-plant formulations. Modern single-molecule drug discovery frequently encounters challenges like off-target

toxicities, rapid resistance, or reduced bio-efficacy when compounds are isolated from their native matrix.

Contemporary pharmacognosy increasingly confirms the rationale behind Ayurvedic multi-constituent administration:

Polypharmacology & Entourage Effect: The naturally occurring chemical diversity within whole-plant extracts (e.g., *Ashwagandha* or *Guduchi*) yields multi-target synergy, where secondary constituents enhance bioavailability or mitigate toxicity—providing a molecular basis for *Prabhava* and balanced *Guna-Karma*interactions.

Methodological Challenges and Research Horizons:

1. **Standardization & Bioavailability:** Plant quality varies based on geographical origin, harvest season (*Ritu*), and processing. High-Performance Liquid Chromatography (HPLC) and Mass Spectrometry (LC-MS) provide the analytical precision required to standardize marker compounds.
2. **Microbiome Interplay:** Advances in metabolomics validate *Vipaka* by showing how human gut microbes transform complex glycosides into bioactive aglycones capable of systemic circulation.
3. **Reverse Pharmacology:** Translational research models leverage historic Ayurvedic clinical documentation to identify therapeutic leads, streamlining target identification and clinical validation cycles.

Conclusion:

The classical Ayurvedic framework of *Dravya-Guna-Karma* represents an early, highly structured approach to systems biology. Integrating these traditional organoleptic and bio-energetic concepts with modern biochemistry, molecular docking, and controlled clinical trials enables modern drug discovery to standardize botanical therapeutics while honoring their inherent multi-target synergy.

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