

**ANUPANA SANKALPANA IN AYURVEDA: A CONCEPTUAL INTERPRETATION
THROUGH EPIGENETICS****Dr. Monal Tembhurne^{1*}, Dr. Amit Avalaskar²**¹Postgraduate Scholar, Department of Dravyaguna Vigyana, Sumatibhai Shah Ayurved Mahavidyalaya, Hadapsar, Pune-411028, Maharashtra, India.²Prof. & H.O.D., Department of Dravyaguna Vigyana, Sumatibhai Shah Ayurved Mahavidyalaya, Hadapsar, Pune-411028, Maharashtra, India.***Corresponding Author: Dr. Monal Tembhurne**Postgraduate Scholar, Department of Dravyaguna Vigyana, Sumatibhai Shah Ayurved Mahavidyalaya, Hadapsar, Pune-411028, Maharashtra, India. DOI: <https://doi.org/10.5281/zenodo.22266662>**How to cite this Article:** Dr. Monal Tembhurne^{1*}, Dr. Amit Avalaskar² (2026). Anupana Sankalpana In Ayurveda: A Conceptual Interpretation Through Epigenetics. World Journal of Pharmaceutical and Medical Research, 12(9), 318–325. This work is licensed under Creative Commons Attribution 4.0 International license.

Article Received on 05/08/2026

Article Revised on 25/08/2026

Article Published on 03/09/2026

ABSTRACT

Anupana, an adjuvant substance administered along with food or medicine, is an integral component of *Ayurvedic* therapeutics. Classical *Ayurvedic* texts describe *Anupana* as enhancing digestion, facilitating absorption, improving bioavailability, promoting systemic distribution and augmenting the therapeutic efficacy of drugs while minimizing adverse effects. Although its pharmacological significance has been extensively documented in *Ayurveda*, its interpretation in the context of contemporary molecular biology remains limited. Epigenetics, the study of heritable yet reversible changes in gene expression without alterations in the DNA sequence, provides a modern framework for understanding how environmental and dietary factors influence biological responses. This article presents a conceptual interpretation of *Anupana* through the lens of epigenetics by correlating its classical attributes with contemporary concepts of pharmacokinetics, pharmacodynamics, cellular signaling and epigenetic regulation. The proposed framework suggests that *Anupana* may influence the therapeutic response by modulating physiological processes that ultimately affect gene expression and individualized treatment outcomes. Rather than establishing a direct molecular equivalence, this interpretation offers a scientifically plausible perspective that bridges traditional *Ayurvedic* wisdom with advances in modern biomedical science. It also highlights potential avenues for future experimental research exploring the epigenetic basis of *Ayurvedic* therapeutic principles.

KEYWORDS: *Anupana*, *Ayurveda*, Epigenetics, Bioavailability, Pharmacological Modulation, Personalized Medicine.**INTRODUCTION**

The therapeutic success of a medicine depends not only on what is administered, but also on how it is administered. *Ayurveda* recognizes this principle through the concept of *Anupana*, which remains one of the most clinically intriguing and scientifically underexplored concepts. Administered along with or immediately after food or medicine, *Anupana* is described as a therapeutic adjuvant that enhances digestion, facilitates absorption, promotes systemic distribution, improves therapeutic efficacy and minimizes undesirable effects.^{[1][2]} The selection of an appropriate *Anupana* is individualized, reflecting the personalized approach of *Ayurveda*.

Recent advances in biomedical science have demonstrated that environmental and dietary factors can influence biological responses beyond their conventional

nutritional and pharmacological roles. Among these advances, epigenetics has emerged as a key field that explains how gene expression can be regulated through reversible molecular modifications without altering the DNA sequence.^[3] These mechanisms play a significant role in determining individual variations in health, disease susceptibility and therapeutic response.

Although the classical importance of *Anupana* has been extensively documented in *Ayurvedic* literature, its interpretation from the perspective of contemporary biological sciences remains limited. The traditional actions attributed to *Anupana* show conceptual similarities with modern pharmacological principles and provide an opportunity to explore this ancient concept through the broader framework of epigenetics. Such an interpretation does not suggest that *Ayurveda* explicitly

described epigenetic mechanisms; rather, it offers a contemporary scientific perspective for understanding the possible biological relevance of this classical therapeutic principle.

The present article presents a conceptual interpretation of *Anupana Sankalpana* through the lens of epigenetics by integrating classical *Ayurvedic* knowledge with current concepts of pharmacology and molecular biology. It aims to stimulate interdisciplinary dialogue and lay a conceptual foundation for future research exploring the molecular basis of *Ayurvedic* therapeutics.

AIM

To explore the conceptual relationship between *Anupana Sankalpana* and epigenetics.

OBJECTIVES

1. To compile and analyze classical references related to *Anupana Sankalpana* from *Ayurvedic* texts.
2. To understand the role of *Anupana* in altering the pharmacological action of drugs.
3. To briefly review the basic principles of epigenetic regulation relevant to drug response.
4. To conceptually correlate *Anupana Sankalpana* with epigenetic mechanisms explaining variable therapeutic outcomes.

CONCEPT OF ANUPANA

The word *Anupana* is derived from the Sanskrit terms

- “*Anu*”, meaning “along with or after,” and
- “*Pana*,” meaning “to consume” (substances labelled as ‘*Anupana*’ can be both, solid and liquid)

अनु सह पश्चात् पीयते इति अनुपानम्॥

(द्रव्यगुणविज्ञान- आचार्य प्रियवत शर्मा)

Thus, *Anupana* refers to a substance taken along with or immediately after medicine; which also applies to food.^[4] *Acharya Vagbhata* describes *Anupana* as the medium administered during or after drug intake.^[5]

According to *Chakrapani* commentary on *Charaka Samhita*, *Anupana* acts as a vehicle facilitating the proper distribution and absorption of drugs in the body.^[1]

DEFINITION OF ANUPANA

तत्तद्रोगघ्नभैषज्यं भेषजस्यानुपीयते।
यच्च साहाय्यकारि स्यादनुपानं तदुच्यते॥
(रसतरंगिणी, तरंग ६/२००)

Anupana is that substance which is consumed along with/after food or medicine and acts in a supportive manner to assist and enhance its action.^[6]

In *Ayurveda*, *Anupana* is considered an essential component of treatment because it influences the pharmacological action of medicines.

यथा तैलं जले क्षिप्तं क्षणेनैव प्रसर्पति
अनुपानबलादङ्गे तथा सर्पति भेषजम्॥
(शा.सं.म.ख.६/५)

Just like a drop of oil rapidly spreads across the surface of water, an *Anupana* helps carry and spread the therapeutic properties (*Rasa*, *Veerya*) of a drug swiftly and effectively throughout the body.^[7] *Anupana* facilitates the **rapid and uniform distribution of drugs throughout the body**, thereby contributing to efficient therapeutic action.

TYPES OF ANUPANA

Anupana can be classified based on different criteria.^[8]

1. Based on Physical Form

- *Drava Anupana* – liquid form such as water, milk, ghee
- *Shushka Anupana* – solid form such as sugar or jaggery

2. Based on Therapeutic Utility

- *Aharopayogi Anupana* – used with food
- *Aushadhopayogi Anupana* – used with medicines

COMMON EXAMPLES OF ANUPANA

Several substances are described in *Ayurvedic* literature as *Anupana* depending on disease condition, dosha predominance and nature of the drug.^{[1][5][8]}

Table 1: Classical examples of *Anupana* and their potential influence on therapeutic response.

<i>Anupana</i>	Therapeutic Role in <i>Ayurveda</i>	Possible Biological Interpretation
Water (<i>Jala</i>)	Facilitates digestion and drug absorption	Improves dissolution and bioavailability
Warm Water (<i>Ushna Jala</i>)	Enhances digestion, clears channels, reduces <i>Kapha</i>	Improves gastrointestinal motility and absorption
Cold Water (<i>Sheeta Jala</i>)	Provides cooling and relieves thirst and burning sensation	Reduces metabolic heat and provides physiological cooling
Milk (<i>Ksheera</i>)	Nourishing, strengthening, rejuvenating	Provides nutritional support and metabolic modulation
Ghee (<i>Ghruta</i>)	Enhances memory, promotes tissue nourishment	Lipid-mediated drug transport and absorption
Honey (<i>Madhu</i>)	Enhances drug potency and tissue	Bioenhancer activity influencing metabolic

	penetration	pathways
Buttermilk (Takra)	Improves digestion and gut health	Supports gut microbiome and metabolic regulation
Curd (Dadhi)	Promotes strength and nourishment	Provides probiotic support and improves gut environment
Butter (Navaneeta)	Cooling, nourishing and strength promoting	Supplies lipids and supports anabolic processes
Oil (Taila)	Lubricating, Vata-pacifying, improves tissue penetration	Enhances lipophilic drug transport and membrane interaction

PROPERTIES OF AN IDEAL ANUPANA

विपरीतं यदन्नस्य गुणैः स्यादविरोधि च।
अनुपानं समासेन, सर्वदा तत्प्रशस्यते॥
(अ.ह.सू.८/५१)

An ideal *Anupana* is that which possesses properties opposite to those of the food or drug, yet remains non-contradictory and compatible with it.^[9]

PROPERTIES OF ANUPANA

अनुपानं तर्पयति, प्रीणयति, ऊर्जयति, बृंहयति, पर्याप्तिमभिनिर्वर्तयति,
भुक्तमवसादयति, अन्नसङ्घातं भिनत्ति, मार्दवमापादयति, क्लेदयति, जरयति,
सुखपरिणामितामाशुव्यवायितां चाहारस्योपजनयतीति॥
भवति चात्र—
अनुपानं हितं युक्तं तर्पयत्याशु मानवम्।
सुखं पचति चाहारमायुषे च बलाय च॥ (च.सू.२७/३२५,३२६)

रोचनं बृंहणं वृष्यं दोषसङ्घातभेदनम्॥
तर्पणं मार्दवकरं श्रमक्लमहरं सुखम्।
दीपनं दोषशमनं पिपासाच्छेदनं परम्॥
बल्यं वर्णकरं सम्यगनुपानं सदोच्यते॥
(सू.सू.४६/४३६-४३८)

अनुपानस्य किं कर्म ? इत्याह----
अनुपानं करोत्यूर्जां तृप्तिं व्याप्तिं दृढाङ्गताम्।
अन्नसङ्घातशौथिल्यविक्लित्तिजरणानि च॥
(अ.ह.सू.८/५२)

Functional Aspect	<i>Charaka Samhita</i> ^[10]	<i>Sushruta Samhita</i> ^[11]	<i>Ashtanga Hridaya</i> ^[12]
Satisfaction / Satiety	<i>Tarpayati</i> – Produces satisfaction	<i>Tarpanam</i> – Provides satisfaction	<i>Triptim</i> – Produces satiety
Nourishment	<i>Prinayati, Brimhayati</i> – Nourishes and promotes tissue growth	<i>Brimhanam</i> – Promotes nourishment	<i>Dridhangatam</i> – Provides tissue stability and nourishment
Energy / Strength	<i>Urjayati, Balaya</i> – Enhances vitality and strength	<i>Balyam, Vrishyam</i> – Promotes strength and vitality	<i>Urjam Karoti</i> – Enhances energy
Digestion / Metabolism	<i>Jarayati, Sukha Parinamitam</i> – Facilitates proper digestion	<i>Deepanam</i> – Stimulates digestion	<i>Jarana</i> – Promotes digestion
Food Breakdown	<i>Anna Sanghatam Bhinatti</i> – Breaks food mass	<i>Dosha Sanghata Bhedanam</i> – Breaks accumulated Doshas	<i>Anna Sanghata Shaithilya</i> – Loosens compact food mass
Softening / Liquefaction	<i>Mardavam Apadayati, Kledayati</i> – Softens and moistens food	<i>Mardavakaram</i> – Produces softness	<i>Viklitti</i> – Moistens and liquefies
Systemic Distribution	<i>Ashu Vyavayitam</i> – Rapid systemic diffusion	—	<i>Vyaptim</i> – Facilitates systemic spread
Dosha Regulation	—	<i>Dosha Shamanam</i> – Pacifies	—

		Doshas	
Relief from Fatigue / Comfort	—	<i>Shrama-Klama-Haram</i> – Relieves fatigue and exhaustion	—
Appetite / Palatability	—	<i>Rochanam</i> – Improves appetite and palatability	—
Thirst Regulation	—	<i>Pipasa Chhedanam</i> – Relieves thirst	—
Longevity / Health Promotion	<i>Ayushe</i> – Supports longevity	<i>Varnakaram</i> – Improves complexion and health	—

These classical descriptions indicate that *Anupana* is not merely a passive vehicle, but an active modulatory factor influencing multiple stages of drug interaction within the body; including digestion, absorption, assimilation, systemic distribution and therapeutic response. These observations provide a conceptual basis for correlating *Anupana Sankalpana* with modern regulatory mechanisms such as epigenetic modulation and context-dependent pharmacological response.

MODE OF ACTION OF ANUPANA

The probable mode of action of *Anupana* may be explained on the basis of *Sambhava Tantrayukti*,^[13] which helps explain the probable sequence of events based on the properties and actions described in the classical texts.

When administered along with food (*Ahara*) or medicine (*Aushadha*), *Anupana* may help in the digestion and absorption of the administered substance. This may improve its bioavailability and facilitate its distribution throughout the body.

According to *Ayurveda*, *Anupana* possesses the property of *Vyavayi*, which enables it to spread rapidly throughout the body before undergoing digestion.^[14] This property may help carry the therapeutic principles of the drug to the target tissues, resulting in the desired therapeutic effect.

ROLE OF ANUPANA IN MODIFICATION OF DRUG ACTION

Classical *Ayurvedic* texts emphasize that the same medicine may produce different therapeutic outcomes when administered with different *Anupanas*. This observation suggests that *Anupana* acts as a **modulatory factor** influencing the pharmacological action of drugs.

Anupana facilitates digestion, absorption and assimilation of medicines and may enhance their penetration into tissues. It also improves palatability and reduces adverse effects associated with certain drugs. Furthermore, *Anupana* may direct the drug toward specific tissues depending on disease condition and *dosha* predominance.

From a pharmacological perspective, *Anupana* may be comparable to modern drug delivery vehicles, adjuvants

or bioavailability enhancers that influence drug absorption and therapeutic response.^[15]

OVERVIEW OF EPIGENETICS

Epigenetics is the branch of biology that studies the changes in gene expression that occur without altering the underlying DNA sequence. While DNA can be compared to a blueprint containing genetic information, epigenetic mechanisms determine which parts of that blueprint are actively used and which remain inactive. These mechanisms allow cells to respond to environmental influences and physiological conditions.

The term "epigenetic" literally means "above the gene." It refers to regulatory processes that influence how genes function rather than changing the genes themselves. As a result, individuals possessing the same genetic information may exhibit different physiological responses depending upon environmental exposures, dietary habits, lifestyle factors and metabolic conditions.^[3]

Three major mechanisms are involved in epigenetic regulation.

1. DNA Methylation

DNA methylation involves the addition of small chemical groups called methyl groups to specific regions of DNA. This process generally suppresses or reduces the expression of particular genes. It may be considered as a biological mechanism that "switches off" certain genetic instructions when they are not required.^[16]

2. Histone Modification

DNA within the cell is wrapped around specialized proteins known as histones. Chemical modifications of these histone proteins alter the degree to which DNA remains tightly or loosely packed. Loosely packed DNA is more accessible and can be actively expressed, whereas tightly packed DNA becomes less accessible for gene expression. Histone modification therefore functions as a regulatory mechanism controlling the availability of genetic information.^[16]

3. Non-Coding RNA-Mediated Gene Regulation

Certain RNA molecules do not participate directly in protein synthesis but instead regulate the activity of other genes. These non-coding RNAs may enhance, suppress or fine-tune gene expression and are increasingly

recognized as important regulators of cellular function and therapeutic response.^[17]

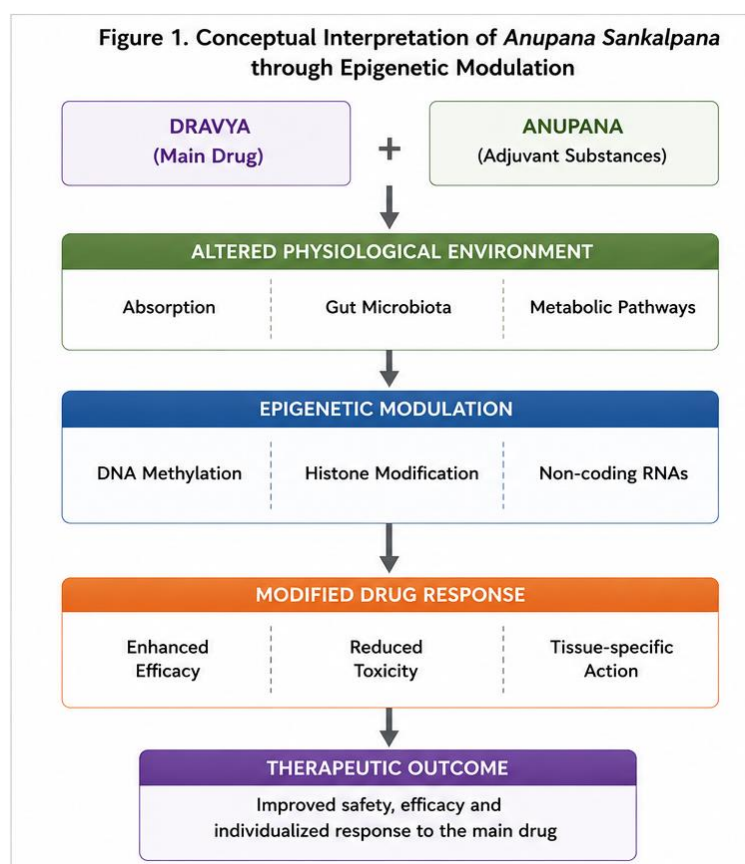
Collectively, these mechanisms influence several physiological processes including metabolism, immune function, inflammation, cellular signalling and drug metabolism. Consequently, epigenetic regulation plays an important role in determining how an individual responds to food, environmental factors and therapeutic interventions.

Modern research has demonstrated that dietary constituents, bioactive plant compounds, lifestyle practices, stress and gut microbial composition can influence epigenetic regulation.^[18] These factors may

alter cellular responses and modify the expression of genes involved in metabolism and pharmacological activity. Thus, therapeutic outcomes are increasingly understood as the result of an interaction between genetic potential and environmental influences.

This concept is particularly relevant to *Ayurveda*, where therapeutic response is not considered to depend solely upon the administered drug but also upon accompanying factors such as *Ahara*, *Vihara*, *Prakriti*, *Dosha* and *Anupana*.^[19] The modern concept of epigenetics therefore provides a useful framework for understanding how external influences can modify biological responses and contribute to variability in therapeutic outcomes.

CONCEPTUAL INTERPRETATION OF ANUPANA SANKALPANA THROUGH EPIGENETIC MODULATION



Anupana Sankalpana is one of the unique therapeutic principles of *Ayurveda*, wherein a substance administered along with or after a drug modifies its therapeutic outcome. Classical texts repeatedly emphasize that the same medicine may exhibit different actions when administered with different *Anupanas*. This observation suggests that *Anupana* functions as an active modifier of drug response rather than merely serving as a vehicle for administration.

Many commonly used *Anupanas* such as milk, ghee, honey, buttermilk, etc. contain bioactive molecules capable of influencing digestion, absorption, metabolism,

tissue distribution and cellular responsiveness. By modifying the internal physiological environment, these substances may alter the manner in which a drug interacts with biological systems.

The classical descriptions of *Anupana* indicate that it influences multiple stages of drug interaction within the body, including disintegration of food and medicines, absorption, systemic distribution, tissue penetration, metabolic transformation and therapeutic expression. Such observations closely resemble modern concepts of pharmacokinetic and pharmacodynamic modulation.

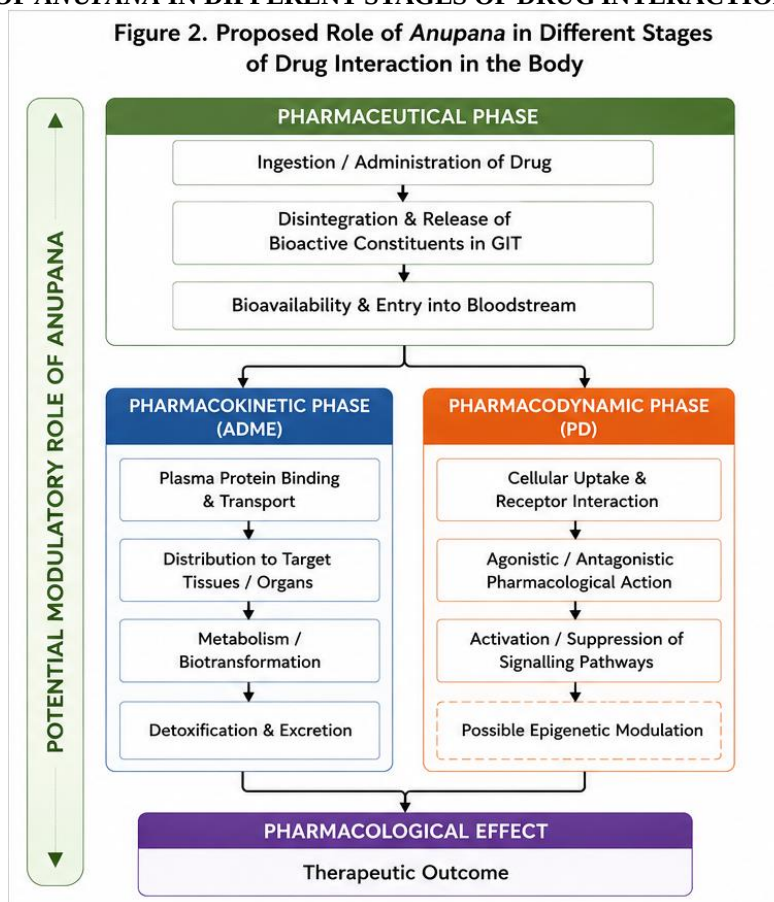
Recent advances in biomedical science suggest that changes in the internal physiological environment can influence cellular activity and gene expression through epigenetic mechanisms. Factors such as diet, nutritional components, gut microbiota and metabolic status are known to affect these regulatory processes.^[20] Since many *Anupanas* are dietary substances, it is reasonable to explore whether their modulatory effects may also be understood from an epigenetic perspective.

For example, *Madhu* (honey) is described as *Yogavahi* and is believed to enhance the action and penetration of co-administered drugs.^[2] *Ghee* facilitates nourishment and tissue penetration, while *Ksheera* (milk) provides a

nourishing and anabolic environment. Such actions may be conceptually understood as modifications of the physiological milieu that influence downstream cellular and molecular responses.

Thus, *Anupana* may be viewed as a factor that modifies the biological context in which a medicine exerts its action. While direct molecular evidence linking *Anupana* with specific epigenetic mechanisms is presently limited, epigenetics offers a plausible scientific framework for understanding how accompanying substances may influence therapeutic response without altering the intrinsic nature of the drug itself.

PROPOSED ROLE OF ANUPANA IN DIFFERENT STAGES OF DRUG INTERACTION IN THE BODY



The proposed figure illustrates the various stages at which *Anupana* may influence drug interaction within the body.

For ease of understanding, the proposed mechanisms are described phase-wise below:

Pharmaceutical Phase

1. Ingestion / Administration of Drug

- Improves palatability, acceptability and ease of administration.
- May promote better patient compliance during drug intake.

2. Disintegration and Release of Bioactive Constituents in GIT

- May facilitate disintegration of the dosage form and release of active constituents.
- May minimize undesirable components and protect the drug until it reaches the intestine, comparable to enteric-coated formulations.

3. Bioavailability and Entry into Bloodstream

- May enhance absorption by modifying the gut environment and intestinal permeability.
- May improve systemic availability and circulation of active constituents.

Pharmacokinetic Phase

1. Plasma Protein Binding and Transport

- May stabilize circulating drug molecules.

- May influence transport of drug molecules through plasma proteins.
- 2. Distribution to Target Tissues / Organs**
 - May facilitate tissue-specific delivery of therapeutic constituents.
 - May promote targeted distribution according to physiological requirements.
 - 3. Metabolism / Biotransformation**
 - May influence enzymatic conversion of drugs.
 - May support metabolic activation or detoxification of drug constituents.
 - 4. Detoxification and Excretion**
 - May assist in neutralization and elimination of toxic metabolites.
 - May contribute to the safety profile of therapeutic interventions.

Pharmacodynamic Phase

- 1. Cellular Uptake and Receptor Interaction**
 - May enhance cellular uptake of the drug.
 - May influence receptor interaction required for therapeutic action.
- 2. Agonistic / Antagonistic Pharmacological Action**
 - May enhance the desired agonistic response.
 - May reduce undesirable or antagonistic pharmacological effects.
- 3. Activation / Suppression of Signalling Pathways**
 - May regulate intracellular signalling pathways involved in therapeutic response.
 - May influence cellular activities.
- 4. Possible Epigenetic Modulation**
 - May modify the biological environment influencing gene expression.
 - May alter cellular responsiveness and metabolic regulation without changing the DNA sequence.

Pharmacological Effect

- May enhance therapeutic efficacy.
- May reduce adverse effects.
- May support tissue-specific and individualized therapeutic response.

The proposed model illustrates that *Anupana* may influence multiple stages of drug interaction, beginning from pharmaceutical processing through pharmacokinetic and pharmacodynamic events. By modifying the internal physiological environment, *Anupana* may alter drug absorption, distribution, metabolism, receptor interaction and downstream cellular signalling, thereby contributing to variability in therapeutic response.

Although direct experimental evidence linking *Anupana* with epigenetic mechanisms remains limited, this conceptual framework provides a plausible scientific interpretation of the classical *Ayurvedic* principle of *Anupana Sankalpana* and highlights potential avenues for future interdisciplinary research.

DISCUSSION

One of the most fascinating observations described in *Ayurveda* is that the therapeutic response to a medicine is not determined by the drug alone, but also by the substance administered along with it. This principle forms the basis of *Anupana Sankalpana*, where a simple change in the accompanying medium may alter the efficacy, safety and tissue-specific action of the same medicine. Although described centuries ago, this idea closely resembles the present understanding that drug response is influenced not only by the drug itself but also by the biological environment in which it acts.

The classical properties attributed to *Anupana*, such as improving digestion, facilitating absorption, promoting systemic distribution and enhancing therapeutic action, can be viewed from the perspective of modern pharmacology. Similarly, growing evidence suggests that diet, nutritional factors, gut microbiota and metabolic status influence cellular function and drug response through mechanisms that include epigenetic regulation. While these concepts arise from different systems of knowledge, they converge on a common idea—that the surrounding biological milieu plays an important role in determining therapeutic outcomes.

Based on this understanding, the present review proposes a conceptual interpretation rather than a direct molecular correlation. The figures presented in this article illustrate how *Anupana* may influence different stages of drug interaction, beginning with pharmaceutical processing and extending through pharmacokinetic and pharmacodynamic events to the final therapeutic response. Viewing *Anupana* in this manner provides a logical explanation for several observations described in the classical texts while remaining consistent with present scientific knowledge.

As of now, direct evidence linking *Anupana* with specific epigenetic changes is limited. Therefore, the proposed correlations should be regarded as a scientific hypothesis that warrants further investigation rather than an established mechanism. Future studies integrating *Ayurveda* with pharmacology, molecular biology and epigenetics may help clarify these relationships and provide a stronger scientific basis for one of *Ayurveda's* most distinctive therapeutic concepts.

CONCLUSION

Anupana has traditionally been regarded as an adjuvant administered along with food or medicine. However, the classical descriptions suggest a much broader role. By influencing digestion, absorption, distribution and therapeutic action, *Anupana* appears to modify the biological context in which a medicine exerts its effect rather than altering the drug itself.

The present review offers a conceptual interpretation of this classical principle through epigenetics. Although *Ayurveda* does not describe molecular mechanisms in

modern scientific terms, the functional role attributed to *Anupana* shows interesting similarities with present knowledge of pharmacokinetic, pharmacodynamic and epigenetic regulation. These similarities provide a meaningful basis for scientific exploration without equating the two systems of medicine.

Further experimental and clinical studies are required to validate the proposed concepts. A better understanding of *Anupana* may not only strengthen the scientific basis of *Ayurvedic* therapeutics but also contribute to the development of more individualized and effective treatment strategies.

Thus, *Anupana* may be viewed not only as an adjuvant to food or medicine but also as a therapeutic modifier that deserves further scientific exploration.

REFERENCES

1. Acharya Agnivesh Charaka Samhita with Ayurveda Deepika Commentary of Chakrapanidatta, Vol.1 Sutra sthana 27/323-325 Hindi translation by Vd. Harish Chandra Singh Kushwaha, Chaukhambha Orientalia, Varanasi, 457.
2. Jaseela VK, Krishna JG. Anupana - a critical review. J Ayurveda Integr Med Sci, 2019; 4(5): 311-7.
3. Feinberg AP. Phenotypic plasticity and the epigenetics of human disease. Nature, 2007; 447(7143): 433-40.
4. Acharya P.V. Sharma, Vol.1, Reprint edition, Chaukhamba Bharati Academy, Varanasi, 2017; 427.
5. Ashtanga Hridayam of Srimad Vagbhata edited with Nirmala Hindi Commentary, Sutra sthana 8/46 Hindi translation by Dr. Brahmanand Tripathi, Reprint edition, Chaukhambha Sanskrit Pratishthan, Delhi, 2017; 142.
6. Rasatarangini of Pranacharya Shri Sadananda Sharma with the Hindi commentary Rasaviijnana by Ayurvedacharya Paṇḍit Dharmananda Shastri, Shashtha Taranga 6/200 Reprint edition, Motilal Banarasidas, Delhi, 1988; 143.
7. Sharangadhara Samhita of Pandita Sharangadharacharya with Dipika Hindi Commentary, Madhyama Khanda 6/5 Hindi translation by Dr. Brahmanand Tripathi, Reprint edition, Chaukhamba Surbharti Prakashan, Varanasi, 2022; 116.
8. Sushruta Samhita of Maharshi Sushruta with Ayurveda Tattva Sandipika Hindi Commentary, Sutra sthana 46/419-439 Hindi translation by Kaviraja Ambikadutta Shastri, Reprint edition, Chaukhambha Sanskrit Pratishthan, Varanasi, 2020; 278-280.
9. Ashtanga Hridayam of Srimad Vagbhata edited with Nirmala Hindi Commentary, Sutra sthana 8/51 Hindi translation by Dr. Brahmanand Tripathi, Reprint edition, Chaukhambha Sanskrit Pratishthan, Delhi, 2017; 143.
10. Charaka Samhita of Agnivesha with Vaidyamanorama Hindi Commentary, Sutra sthana 27/325,326 Hindi translation by Acharya Vidyadhar Shukla and Prof. Ravi Dutt Tripathi, Reprint edition, Chaukhambha Sanskrit Pratishthan, Delhi, 2017; 422.
11. Sushruta Samhita of Maharshi Sushruta with Ayurveda Tattva Sandipika Hindi Commentary, Sutra sthana 46/436-438 Hindi translation by Kaviraja Ambikadutta Shastri, Reprint edition, Chaukhambha Sanskrit Pratishthan, Varanasi, 2020; 280.
12. Ashtanga Hridayam of Srimad Vagbhata edited with Nirmala Hindi Commentary, Sutra sthana 8/52 Hindi translation by Dr. Brahmanand Tripathi, Reprint edition, Chaukhambha Sanskrit Pratishthan, Delhi, 2017; 143.
13. Charaka Samhita of Agnivesha with Vaidyamanorama Hindi Commentary, Siddhi sthana 12/Sambhava Tantrayukti Hindi translation by Acharya Vidyadhar Shukla and Prof. Ravi Dutt Tripathi, Reprint edition, Chaukhambha Sanskrit Pratishthan, Delhi, 2017; 997.
14. Sharangadhara Samhita of Pandita Sharangadharacharya with Dipika Hindi Commentary, Purva Khanda 4/19 Hindi translation by Dr. Brahmanand Tripathi, Reprint edition, Chaukhamba Surbharti Prakashan, Varanasi, 2022; 35.
15. Atal CK, Zutshi U, Rao PG. Biochemical basis of enhanced drug bioavailability by piperine: evidence that piperine is a potent inhibitor of drug metabolism. J Pharmacol Exp Ther, 1985; 232(1): 258-62.
16. Reik W. Stability and flexibility of epigenetic gene regulation in mammalian development. Nature, 2007; 447(7143): 425-32.
17. Kumar S, Gonzalez EA, Rameshwar P, Etchegaray JP. Non-coding RNAs as mediators of epigenetic changes in malignancies. Cancers (Basel), 2020; 12(12): 3657.
18. Pepke ML, Hansen SB, Limborg MT. Unraveling host regulation of gut microbiota through the epigenome-microbiome axis. Trends Microbiol, 2024; 32(12): 1229-40.
19. Prasher B, Negi S, Aggarwal S, Mandal AK, Sethi TP, Deshmukh SR et al. Whole genome expression and biochemical correlates of extreme constitutional types defined in Ayurveda. J Transl Med, 2008; 6: 48.
20. Kim B, Song A, Son A, Shin Y. Gut microbiota and epigenetic choreography: implications for human health: a review. Medicine (Baltimore), 2024; 103: e39051.