

**EXCIPIENTS IN MODERN AND AYURVEDIC PHARMACEUTICS: A COMPARATIVE
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ABSTRACT

Excipients are pharmacologically inactive substances that play a vital role in the design, development, and delivery of pharmaceutical formulations. Their contribution extends beyond formulation stability and manufacturability to drug bioavailability and patient compliance. In modern pharmaceutics, excipients are chemically defined, highly regulated, and often synthetic or semi-synthetic in nature. Conversely, the Ayurvedic system of medicine has long utilized natural excipients—referred to by terms such as *Anupana*, *Sahapana*, and *Prakshep Dravya*—which not only serve as carriers but often possess therapeutic value themselves. In light of the growing interest in biocompatible, biodegradable, and plant-based excipients, Ayurveda's wisdom offers promising insights into sustainable and holistic drug formulation practices. This review critically explores the definition, classification, and functional roles of excipients from both modern and Ayurvedic perspectives. It also identifies herbal and natural excipients as potential integrative tools for bridging traditional knowledge with contemporary pharmaceutical innovations. Regulatory standards, recent developments, and challenges in excipient selection and safety are also discussed to highlight the translational value of Ayurvedic pharmaceutics in the modern pharmaceutical industry.

KEYWORDS: Excipients, Ayurveda, *Anupana*, Bioavailability, Herbal excipients, Pharmaceutics, IPEC, WHO, Bhaishajya Kalpana, Drug delivery.**INTRODUCTION**

Excipients have emerged as essential components in pharmaceutical formulations, not simply as inert substances, but as functional ingredients that influence drug performance, stability, and patient adherence. In modern pharmaceutics, they are utilised to facilitate manufacturing processes, improve organoleptic properties, control drug release kinetics, and enhance the bioavailability of active pharmaceutical ingredients (APIs).^[1] These substances may comprise up to 90% of a given dosage form, particularly in oral solid dosage types such as tablets and capsules.^[2] Regulatory agencies, including the World Health Organisation (WHO), International Pharmaceutical Excipients Council (IPEC), and India's Drugs and Cosmetics Act have issued

comprehensive definitions and quality standards for excipients, reflecting their vital role in drug development.^[3–5]

While modern science emphasises chemically defined and industrially scalable excipients, there is increasing interest in the safety and sustainability of these components. Concerns over synthetic excipient toxicity, environmental degradation, and consumer demand for plant-based ingredients have led researchers and formulators to explore natural alternatives.^[6] In this context, Ayurveda—the ancient Indian system of medicine—offers a profound and time-tested understanding of excipients through concepts such as *Anupana* (co-administered vehicles), *Sahapana*

(substances taken with drugs), *Yogavahi* (synergistic carriers), and *Bhavana Dravya* (media used in drug processing).^[7] These natural excipients are not merely delivery agents; they are therapeutically active, chosen based on the principles of *Rasa* (taste), *Guna* (quality), *Virya* (potency), *Vipaka* (post-digestive effect), and *Prabhava* (specific action).^[8]

The present review aims to provide a comparative analysis of excipients used in modern and Ayurvedic pharmaceuticals. By examining the definitions, classifications, functions, and evolving regulatory standards, the article seeks to highlight the translational potential of Ayurvedic excipients in contemporary pharmaceutical applications. With the integration of traditional knowledge and modern scientific validation, natural excipients may serve as the next frontier in sustainable and effective drug formulation.

Role of Excipients in Modern Pharmaceuticals

In modern pharmaceuticals, excipients are critical functional components that influence manufacturability, stability, pharmacokinetics, and patient acceptability. They facilitate efficient processing by improving flowability, compressibility, and mechanical strength of dosage forms, with commonly used classes including diluents (e.g., lactose, microcrystalline cellulose), binders (e.g., starch, polyvinylpyrrolidone), lubricants (e.g., magnesium stearate), and disintegrants (e.g., sodium starch glycolate).^[9,10]

Excipients also enhance physicochemical stability by protecting active pharmaceutical ingredients from degradation pathways such as hydrolysis, oxidation, and microbial contamination. From a biopharmaceutical perspective, they modulate drug dissolution, permeability, and absorption; for instance, surfactants like polysorbate 80 improve solubility and oral bioavailability, while polymers such as hydroxypropyl methylcellulose and ethyl cellulose enable controlled drug release and sustained plasma concentrations.^[11,12]

Additionally, excipients play a key role in patient-centric formulation design by improving palatability and acceptability through flavouring agents, sweeteners, and colorants, particularly in orally disintegrating systems¹³. Their selection is governed by stringent regulatory frameworks, including ICH Q8–Q10 guidelines and Good Manufacturing Practices, ensuring safety, quality, and consistency.^[14,15] With advances in drug delivery, excipients are increasingly utilised in sophisticated systems such as nanoparticles, liposomes, and transdermal platforms, underscoring their role as active modulators of drug delivery and therapeutic performance.^[16]

Ayurvedic Perspective on Excipients

Ayurvedic pharmaceuticals, known as *Bhaishajya Kalpana*, demonstrates a sophisticated and holistic understanding of formulation science, including the use

of substances that function similarly to modern excipients. While Ayurveda does not employ the term “excipient” as defined in modern pharmaceutical science, it extensively uses various supportive agents under categories such as *Anupana*, *Sahapana*, *Bhavana Dravya*, *Prakshepa Dravya*, and *Yogavahi*—each playing a functional role in the processing, delivery, and enhancement of drug efficacy.^[17]

Anupana refers to substances taken along with the main drug to aid its absorption, distribution, or reduction of side effects. Common examples include milk, honey, ghee, and water, which are selected based on their compatibility with the *dosha* involved and the therapeutic aim. *Sahapana* denotes agents consumed simultaneously with medicine and may overlap in functionality with *Anupana*. *Yogavahi* are unique substances believed to carry the drug's action to specific target tissues without modifying the drug's inherent activity. Ghee and honey are classic examples of *Yogavahi* due to their tissue-penetrating and potentiating effects.^[18]

Bhavana Dravya represents liquids used during the trituration (*Bhavana*) process, believed to potentiate the formulation through subtle biochemical transformations. These substances are often herbal juices or decoctions that enhance both the pharmacokinetic and pharmacodynamic properties of the main drug. Likewise, *Prakshepa Dravya* are final-stage additives that improve palatability, preservation, or synergistic effect—such as *Trikatu* (a mixture of long pepper, black pepper, and ginger), salt, or jaggery. These substances may be considered analogous to modern binders, preservatives, or flavouring agents.^[19,20]

Ayurvedic literature does not consider any part of the formulation as pharmacologically inert. Every component is chosen based on a detailed understanding of *Rasa* (taste), *Guna* (qualities), *Virya* (potency), *Vipaka* (post-digestive transformation), and *Prabhava* (specific effect), which determine their therapeutic compatibility and contribution to the overall action of the formulation.^[21] For instance, ghee is used in *Medhya Rasayanas* (nootropic formulations) for its ability to cross the blood–brain barrier, while honey is employed for its penetrating and preservative effects in herbal jams (*Avaleha*) and fermented preparations like *Asava-Arishta*.

These excipient-like substances are functionally active, often possessing anti-inflammatory, digestive, immunomodulatory, or antioxidant properties. Their dual role—as facilitators of drug delivery and contributors to therapeutic effect—marks a significant philosophical divergence from the inert excipient model of modern pharmaceuticals.

With the rise of integrative medicine and increased interest in plant-based and natural healthcare, these

traditional excipients are attracting renewed scientific scrutiny. Recent studies have attempted to evaluate their physicochemical characteristics, safety profiles, and bioenhancing mechanisms through modern analytical and pharmacological tools.^[22] As such, Ayurvedic

excipients, long validated by empirical practice and textual authority, are now being reinterpreted through the lens of modern pharmaceutical science, creating pathways for innovation and cross-disciplinary integration.

Table no. 1: Types of Ayurvedic Formulations and Corresponding Excipients.

Formulation	Excipient Used
Vati (Tablets)	Ghee, jaggery, honey, starch, water
Avaleha (Confection)	Sugar, ghee, oil, herbal decoctions
Asava–Arishta	Sugar, jaggery, natural alcohol (self-generated)
Churna (Powders)	<i>Anupana</i> or <i>Prakshep Dravyas</i> for taste/efficacy
Taila/Ghrita (Oils/Ghee)	Lipid media for drug solubilization and delivery

Comparative Analysis of Modern vs Ayurvedic Excipients

A comparative evaluation of modern and Ayurvedic excipients reveals fundamental differences in conceptual framework, source, and functionality, while also indicating potential for integration. Modern pharmaceuticals emphasizes chemically defined, functionally inert excipients selected for specific physicochemical properties such as compressibility, flowability, and stability to ensure consistency, scalability, and regulatory compliance.^[23-27] These excipients are typically synthetic or semi-synthetic and designed for targeted roles in formulation development.

In contrast, Ayurvedic excipients are natural and inherently bioactive, derived from plant, animal, or mineral sources. Substances such as honey, ghee, milk,

and herbal decoctions are selected based on pharmacodynamic attributes like *Virya* and *Vipaka*, contributing to drug absorption, targeting, and therapeutic modulation.^[28,29] Unlike modern excipients with singular roles, Ayurvedic excipients exhibit multifunctionality, acting as carriers, preservatives, and bioenhancers. For instance, *Trikatu* enhances bioavailability, while ghee facilitates lipid-mediated drug delivery and tissue targeting.^[30]

Furthermore, modern pharmaceuticals prioritizes component standardization, whereas Ayurveda adopts a synergistic approach in which all formulation constituents contribute to the overall therapeutic effect. This is exemplified by polyherbal formulations and *Bhavana* processes that enhance drug potency and compatibility.^[31]

Table no. 2: Source of Excipients.

Aspect	Modern	Ayurvedic
Origin	Synthetic, semi-synthetic, some natural	Entirely natural (plant, animal, mineral)
Examples	MCC, HPMC, talc, PEG, sodium starch glycolate	Ghee, honey, jaggery, cow urine, starch, herbal decoctions
Preference	Chemically defined, reproducible	Biocompatible, bioenhancing, traditional

Table no. 3: Role and Functionality.

Function	Modern	Ayurvedic
Binder	PVP, starch, cellulose	Jaggery, honey, starch
Disintegrant	Croscarmellose, SSG	Mucilages, powdered herbs
Bioenhancer	Piperine (recent use), surfactants	<i>Trikatu</i> , <i>Bhallataka</i> , cow urine
Flavoring agent	Artificial sweeteners, menthol	<i>Pippali</i> , <i>Ela</i> , sugar, honey
Solubilizer/Carrier	PEG, cyclodextrins	<i>Taila</i> (oil), <i>Ghrita</i> (ghee), milk
Preservatives	Parabens, sorbates	Alcohol (from <i>Asava-Arishta</i>), honey

Despite their respective strengths, both systems face limitations. Synthetic excipients have been linked to allergic reactions, gastrointestinal intolerance, and environmental pollution due to non-biodegradability.^[32] Ayurvedic excipients, on the other hand, may suffer from issues such as batch-to-batch variability, microbial contamination, and limited shelf life unless appropriately processed and preserved.^[33] Moreover, the lack of standardised analytical parameters and global regulatory

recognition limits the use of Ayurvedic excipients in mainstream pharmaceutical production.

Nonetheless, the trend towards “green pharmaceuticals” and sustainable healthcare has generated considerable interest in natural excipients. Their inherent safety, multifunctionality, and biocompatibility, coupled with advances in standardisation and scientific validation, position Ayurvedic excipients as promising alternatives

or adjuncts to modern ones. The convergence of traditional wisdom with contemporary formulation science could lead to more holistic, effective, and patient-friendly pharmaceutical products.

Herbal and Natural Excipients – A Bridge Between Systems

The increasing demand for biocompatible and sustainable excipients has renewed interest in herbal and natural substances traditionally employed in Ayurvedic pharmaceuticals. These excipients provide functional performance comparable to synthetic agents while reducing toxicological and environmental risks.^[34-36]

Natural excipients are predominantly plant-derived, including gums, mucilages, starches, resins, and oils. Agents such as acacia and tragacanth serve as binders and emulsifiers, while starch and psyllium function as

disintegrants and bulk-forming agents. Polymers like guar gum, pectin, agar, and xanthan gum contribute to viscosity, suspension, and gel formation in dosage systems.^[37-39] Additionally, animal-derived substances such as honey and ghee act as bioenhancers and lipid-based carriers, improving drug solubility and tissue distribution.^[40,41]

A key advantage of herbal excipients is their multifunctionality, combining formulation roles with intrinsic bioactivity, including antioxidant and antimicrobial effects, thereby enhancing therapeutic efficiency and reducing formulation complexity.^[42,43] Moreover, certain agents such as *Trikatu* exhibit bioenhancing properties by improving drug absorption and bioavailability through modulation of gastrointestinal and metabolic processes.^[41]

Table 4: Common Herbal and Natural Excipients Used Today.

Herbal/Natural Excipient	Function	Source
Tragacanth gum	Binder, thickener	<i>Astragalus gummifer</i>
Acacia gum	Binder, emulsifier	<i>Acacia senegal</i>
Starch	Binder, disintegrant	Rice, maize, potato
Pectin	Gelling agent, thickener	Citrus peels, apples
Guar gum	Disintegrant, viscosity enhancer	<i>Cyamopsis tetragonolobus</i>
Psyllium husk	Disintegrant, bulk-forming laxative	<i>Plantago ovata</i>
Honey	Binder, sweetener, preservative	<i>Apis mellifera</i>
Ghee (clarified butter)	Lipid-based carrier	Cow milk
Jaggery (Guda)	Binder, sweetener, preservative	Sugarcane, date palm

Despite their advantages, the integration of herbal excipients into modern formulations faces significant challenges, including batch-to-batch variability, microbial contamination, suboptimal flow properties, and limited shelf stability, which restrict industrial scalability.^[36,39] Regulatory barriers and the absence of standardised pharmacopeial monographs further limit their global acceptance.^[44] However, advances in extraction technologies, drying processes, microbial decontamination, and analytical validation are progressively improving their quality and reproducibility.^[45]

Growing scientific interest is reflected in the increasing application of natural polymers such as chitosan, alginate, and pectin in advanced drug delivery systems, including nanoformulations, sustained-release, and mucoadhesive platforms. Polysaccharides like tamarind seed polymer and modified starches are being explored for targeted and site-specific delivery.^[46]

The shift toward “clean-label” and sustainable pharmaceuticals underscores the relevance of herbal excipients across pharmaceutical, nutraceutical, and cosmeceutical domains. Their integration, supported by mechanistic validation and standardisation, offers a promising strategy for developing eco-friendly and functionally advanced drug delivery systems.^[47]

Pharmaceutical and Therapeutic Implications

Excipients—synthetic or natural—are critical determinants of pharmaceutical performance, influencing formulation stability, pharmacokinetics, pharmacodynamics, and patient compliance.^[48-50] In modern pharmaceuticals, they modulate ADME profiles by enhancing solubility, permeability, and drug release kinetics. Surfactants and co-solvents improve dissolution and membrane transport of poorly soluble drugs, while polymers such as carbopol, hydroxypropyl methylcellulose, and ethyl cellulose enable sustained and controlled drug release, optimizing therapeutic exposure and adherence.^[51-53]

Ayurvedic pharmaceuticals similarly employs bioactive adjuncts such as *Anupana* and *Yogavahi* to modulate drug kinetics and tissue targeting. Lipid-based carriers like ghee enhance membrane permeability and systemic distribution, while *Trikatu* acts as a bioenhancer by promoting absorption and influencing metabolic pathways.^[54,55] Additionally, synergistic formulation strategies, including the use of *Prakshep Dravya*, contribute to enhanced efficacy and reduced toxicity, paralleling modern combination approaches.^[56,57]

Excipients also play a central role in patient-centric design through taste masking, aesthetic modification, and improved dosage acceptability, as seen in both modern dosage forms and traditional preparations such as

Avaleha.^[58,59] Safety evaluation remains essential; while synthetic excipients are rigorously regulated, concerns regarding toxicity persist, driving interest in biocompatible alternatives.^[50,60] Ayurvedic excipients offer a promising profile but require systematic standardization and validation.^[61]

Overall, excipients function as active modulators of drug delivery, and their integration with modern analytical and pharmacokinetic approaches offers significant potential for developing safe, effective, and patient-centric formulations.^[48,57]

Challenges and Future Scope

Despite increasing interest in both synthetic and natural excipients, several challenges limit their optimal pharmaceutical application. A key limitation of Ayurvedic excipients is the lack of standardization, as variability in geographical origin, seasonal factors, and processing methods leads to inconsistent physicochemical properties, affecting product quality, safety, and efficacy.^[62] Furthermore, inadequate toxicological data restrict their regulatory acceptance, while issues such as microbial contamination and limited shelf stability hinder large-scale utilization.^[63]

In contrast, synthetic excipients raise concerns regarding biocompatibility, toxicity, and environmental sustainability, particularly due to their petrochemical origin and poor biodegradability.^[64-66] These concerns have driven the demand for safer and sustainable alternatives.

Future advancements require integration of traditional Ayurvedic knowledge with modern scientific validation. Advanced analytical techniques such as FTIR, HPTLC, GC-MS, and NMR can support molecular characterisation and quality control, while regulatory harmonisation and pharmacopeial standardisation are essential for global acceptance. Additionally, natural excipients demonstrate potential in advanced drug delivery systems, including controlled-release and targeted delivery platforms.

Overall, interdisciplinary collaboration, standardisation, and mechanistic validation are crucial to developing sustainable, bioactive, and patient-centric excipient systems.

CONCLUSION

Excipients are now recognized as critical modulators of drug product performance, significantly influencing pharmacokinetic parameters such as absorption, distribution, metabolism, and excretion. In modern pharmaceuticals, excipients are selected based on defined physicochemical properties to optimize dissolution, permeability, and release kinetics, thereby enhancing systemic bioavailability and therapeutic efficacy under stringent regulatory control.

In contrast, Ayurvedic pharmaceuticals employs bioactive excipient analogues—*Anupana*, *Sahapana*, *Prakshepa Dravya*, and *Yogavahi*—which actively modulate pharmacokinetic and pharmacodynamic responses. These agents enhance intestinal absorption, facilitate tissue targeting, and may influence metabolic pathways. Lipid-based carriers such as ghee improve membrane permeability, while bioenhancers like *Trikatu* are associated with increased drug absorption and enzyme modulation.

While modern excipients ensure precision and reproducibility, Ayurvedic excipients provide multifunctionality and synergistic bioenhancement. Integrating these systems requires systematic characterization of natural excipients in terms of permeability modulation, enzyme interaction, and pharmacokinetic profiling.

Advancing this integration through standardization and mechanistic validation may enable the development of sustainable, bioactive excipient systems aligned with contemporary drug delivery strategies.

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