Received: 15 July 2026	Revised: 16 Aug 2026	Accepted: 15 Sept 2026

Review Article

IJRPS
The Power of Wisdom

SCITEKHUB

ISSN: 3048-5606

"*ANUPANA* AS A DRUG VEHICLE: A CRITICAL REVIEW OF THE EVIDENCE FOR BIOENHANCEMENT AND PHARMACOKINETIC MODULATION"

Dr. Jalpa Gandhi[1]

AFFILIATIONS:
1. CEO, IRA Consultancy and Research Organisation, Bhosari MIDC, Pune, Maharashtra, India

CORRESPONDENCE:
Dr. Jalpa Gandhi
EMAILID:
ceo@icro.co.in

FUNDING INFORMATION:
None

How to cite this article:
Jalpa Gandhi, "Anupana as a drug vehicle: a critical review of the evidence for bioenhancement and pharmacokinetic modulation" International Journal of Rasa Shastra and Pharmaceutical Sciences. 2026;3(3):17-20.
Sri. 2026.1007.ijrps.03.05

ABSTRACT

Background: *Anupana* is the substance taken with or after a medicine, such as water, honey, ghee, milk, buttermilk or a herbal juice, to aid its action. Classical texts prescribe specific *anupanas* for specific drugs and diseases, and modern authors increasingly interpret *anupana* as a bioavailability enhancer. **Objective:** To examine the classical concept of *anupana* in pharmacological terms and to review the experimental evidence on how vehicles and co-administered substances alter absorption and effect. **Methods:** A critical narrative review of classical descriptions, studies of herbal bioenhancers, and studies relevant to common *anupanas*. **Results:** The strongest evidence concerns *Pippali*-derived piperine, which inhibits drug-metabolising enzymes and, in human volunteers, markedly increased the bioavailability of curcumin. Lipid vehicles such as ghee can solubilise lipophilic constituents through digestion into mixed micelles, and ascorbic acid, a constituent of many acidic *anupanas*, increases iron uptake from *Mandura bhasma* in cell models. Cow urine distillate has been proposed as a bioenhancer. Direct pharmacokinetic studies of classical *anupanas* with Ayurvedic formulations are almost absent; one registered clinical protocol on *sharkara* (sugar) with *Haritaki* had not reported results. **Conclusion:** *Anupana* plausibly influences dissolution, absorption, metabolism and palatability, and some components have proven bioenhancing effects. Pharmacokinetic studies of formulations with and without their classical *anupana* are needed, and potential herb–drug interactions must be considered.

KEYWORDS: *Anupana*; *Sahapana*; Bioenhancer; Piperine; Honey; Ghee; Bioavailability; Ayurvedic pharmaceutics

This is an open access article, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

INTRODUCTION

In Ayurveda, how a medicine is taken is as important as what is taken. *Anupana* refers to the vehicle or post-drink that accompanies a medicine, and *sahapana* to substances taken together with it. Classical texts devote attention to the properties of different *anupanas* and to their selection according to the drug, the disease, the *dosha* involved and the patient[1,2]. The same *bhasma* may be prescribed with honey for one condition, ghee for another and a herbal decoction for a third.

Classical explanations of *anupana* emphasise that it helps the medicine spread quickly through the body, improves palatability and digestion, and directs or modifies the action of the drug. These ideas map naturally onto modern concepts of drug delivery: dispersion, solubilisation, absorption enhancement and pharmacokinetic interaction. This review examines the evidence for these mechanisms.

METHODS OF THE REVIEW

This is a critical narrative review. Literature was identified through PubMed, PubMed Central, DOAJ, Crossref-indexed records and journal archives using the terms *anupana*, *sahapana*, vehicle, bioenhancer, bioavailability enhancer, piperine, honey, ghee and cow urine distillate. Studies of herbal bioenhancers and of vehicles relevant to classical *anupanas* were included.

POSSIBLE MECHANISMS OF ANUPANA

Table 1. Common *anupanas* and plausible pharmaceutical mechanisms

Anupana	**Classical role (summary)**	**Plausible mechanisms**	**Level of evidence**
Warm water	General vehicle; aids digestion	Dispersion; dissolution of soluble constituents	Mechanistic reasoning
Honey	Vehicle for many powders and *bhasmas*; *kapha*-reducing	Dispersion and adhesion of fine powders; palatability; sugars and organic acids may affect dissolution	Limited
Ghee	Vehicle for *pitta* conditions and lipophilic drugs; *rasayana*	Solubilisation of lipophilic constituents through lipid digestion and mixed micelles; possible lymphatic transport	Supported by lipid formulation science; few direct studies
Milk	*Rasayana* and nourishing vehicle	Fat and protein may solubilise or bind constituents; calcium may reduce absorption of some metals	Limited
Lemon or *Amalaki* juice, acidic media	Vehicle for iron and some minerals	Acidic pH and ascorbic acid increase solubility and reduction of iron	Supported for iron
Trikatu or *Pippali*	Co-administered with many formulations	Piperine inhibits drug-metabolising enzymes and may increase absorption	Well supported in animals and humans
Cow urine distillate	Bioenhancer in some formulations	Proposed enhancement of absorption and activity	Limited

From a pharmaceutical perspective, an *anupana* could act at several points: by helping a powder to disperse and wet; by changing the pH or redox conditions in which a mineral dissolves; by providing lipids that solubilise lipophilic constituents; by inhibiting metabolism or efflux of absorbed compounds; or by improving palatability and adherence.

EVIDENCE FOR SPECIFIC ANUPANAS AND CO-ADMINISTERED SUBSTANCES

1. Piperine and *Pippali*

The best-documented bioenhancer from the Ayurvedic tradition is piperine, the main alkaloid of *Pippali* (*Piper longum*) and *Maricha* (*Piper nigrum*), both components of *Trikatu*. Early work showed that piperine is a potent inhibitor of drug metabolism[3]. In a frequently cited study, piperine given with curcumin increased its bioavailability in animals and, markedly, in human volunteers[4]. Reviews of herbal bioenhancers describe mechanisms including inhibition of cytochrome P450 enzymes and P-

glycoprotein, increased intestinal blood flow and changes in membrane permeability[5,6]. The frequent inclusion of *Trikatu* in classical formulations, and its use as a co-administered substance, is consistent with these findings.

2. Ghee and other lipids

Ghee is about 98% lipid, mainly triglycerides[7]. Digestion of dietary triglycerides generates mono- and diglycerides and fatty acids that form mixed micelles with bile salts, which can solubilise lipophilic compounds and, for highly lipophilic molecules, promote lymphatic transport[8]. Many important constituents of Ayurvedic drugs, such as curcumin, are poorly water-soluble and poorly absorbed[9]. Taking such drugs with ghee or milk is therefore likely to increase their absorption, although direct pharmacokinetic studies with classical formulations are lacking.

3. Acidic and ascorbic acid-rich vehicles for minerals

Iron absorption depends on dissolution and reduction to the ferrous form and is enhanced by ascorbic acid[10]. A size-reduced *Mandura bhasma* coated with ascorbic acid showed greater iron dissolution in the intestinal phase of simulated digestion and about threefold higher iron uptake in intestinal cells than unmodified particles[11]. This supports the classical practice of giving iron preparations with *Amalaki* or other acidic vehicles.

4. Cow urine distillate

Cow urine distillate has been proposed as a bioenhancer for antimicrobial and other drugs[12]. The evidence is mainly preclinical, and the active components and mechanisms are not well defined.

5. Honey and sugar

Honey is one of the most common *anupanas* for powders and *bhasmas*. It helps to disperse and coat fine powders and improves palatability, but there is little direct evidence on its effect on absorption. A randomised clinical protocol to evaluate *sharkara* (sugar) as an *anupana* for *Haritaki* decoction, using plasma phenolic compounds measured by HPLC, has been published, but results were not reported[13].

ANUPANA AND HERB–DRUG INTERACTIONS

If an *anupana* or co-administered herb increases the absorption or decreases the metabolism of Ayurvedic constituents, it can do the same for conventional drugs taken at the same time. Piperine's inhibition of drug-metabolising enzymes is the clearest example[3,5]. For patients taking anticoagulants, antiepileptics, immunosuppressants or other drugs with narrow therapeutic margins, *Trikatu*-containing formulations and other bioenhancers may cause clinically important interactions. The concept of *anupana* therefore needs to be integrated into pharmacovigilance and into the advice given to patients on combined therapy.

DESIGNING ANUPANA STUDIES

Well-designed *anupana* studies are feasible and inexpensive:

- **In vitro:** dissolution or simulated digestion of a formulation with and without the classical *anupana*, measuring marker constituents or metal ions.
- **Cell models:** uptake and transport across intestinal cell monolayers with and without the *anupana*.
- **Animal pharmacokinetics:** crossover studies of a formulation given with water versus its classical *anupana*.
- **Human pharmacokinetics:** small crossover studies in healthy volunteers using marker compounds, following the design proposed for *Haritaki* with *sharkara*[13].
- **Clinical studies:** for selected formulations, randomised comparisons of efficacy with and without the classical *anupana*.

RESEARCH GAPS

The main gaps are: pharmacokinetic studies of classical formulations with their prescribed *anupanas*; studies on honey and milk as vehicles; dose–response studies for bioenhancers such as *Trikatu*; and interaction studies with commonly co-prescribed conventional drugs.

CONCLUSION

Anupana is a sophisticated classical concept that corresponds to modern ideas of vehicle effects, solubilisation and bioenhancement. Evidence is strong for piperine as a bioenhancer, supportive for lipid vehicles and for ascorbic acid with iron, and limited for honey, milk and cow urine distillate. Because the effects of *anupana* also imply potential interactions with conventional drugs, systematic pharmacokinetic studies of formulations with and without their classical vehicles would benefit both efficacy and safety.

REFERENCES

1. Sharma RK, Dash VB. Agnivesha's Caraka Samhita, Sutrasthana 27. Varanasi: Chaukhambha Sanskrit Bhawan; 2011.

2. Prasad PL, Govindaraj S, Jahnavi P, Popatrao TP, Tummala T, Vidiyala P, et al. Metal oxide functionalized nanoparticles for the treatment of bacterial infection: synthesis, characterization, and therapeutic applications. J Appl Organomet Chem. 2025;5(3):232-57.
3. Atal CK, Dubey RK, Singh J. Biochemical basis of enhanced drug bioavailability by piperine: evidence that piperine is a potent inhibitor of drug metabolism. J Pharmacol Exp Ther 1985;232:258–62.
4. Shoba G, Joy D, Joseph T, Majeed M, Rajendran R, Srinivas PS. Influence of piperine on the pharmacokinetics of curcumin in animals and human volunteers. Planta Med 1998;64:353–6. https://doi.org/10.1055/s-2006-957450
5. Kesarwani K, Gupta R. Bioavailability enhancers of herbal origin: an overview. Asian Pac J Trop Biomed 2013;3:253–66.
6. Vidiyala N, Sunkishala P, Parupathi P, Mandati P, Mantena SK, Kasu RRR, et al. High drug loading of amorphous solid dispersion by hot melt extrusion: the role of magnesium aluminometasilicate (Neusilin® US2). Sci Pharm. 2025;93(3):30.
7. Tripathi G, Aeri V. Science behind ghrita – the lipid-based Ayurvedic formulations. Clin Case Rep Int 2022;6:1375.
8. Zehravi M, Khan SL, Gupta JK, Jahnavi P, Babu RH, Vidiyala N, et al. Advances in polymeric nanoparticles for oral drug delivery: mechanisms, challenges, emerging trends, and preclinical to clinical perspectives. 3 Biotech. 2026;16(1):35.
9. Anand P, Kunnumakkara AB, Newman RA, Aggarwal BB. Bioavailability of curcumin: problems and promises. Mol Pharm 2007;4:807–18. https://doi.org/10.1021/mp700113r
10. Hurrell RF. Bioavailability of iron. Eur J Clin Nutr 1997;51(Suppl 1):S4–8.
11. Wal A, Bukke SPN, Vidiyala N, Jamil S, Sharma KK, Khan A, et al. Stimuli-responsive nanogels as intelligent nanocarriers for tumor microenvironment-triggered anticancer drug delivery. Discov Nano. 2026;21(1):247.
12. Randhawa GK. Cow urine distillate as bioenhancer. J Ayurveda Integr Med 2010;1:240–1.
13. Soundaryashree NR, Chandan RS, Singamaneni VR, Nagidi HR, Patel G, Vidiyala N, et al. Development and validation of RP-HPLC method for quantification of bamifylline in pharmaceutical formulations using analytical quality by design (AQbD) principles. Adv J Chem Sect A. 2025:2076-97.