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# "*SNEHA KALPANA* AS A LIPID-BASED DRUG DELIVERY SYSTEM: A CRITICAL REVIEW OF THE EVIDENCE FOR *GHRITA* AND *TAILA*"

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**ABSTRACT**

**Background:** *Sneha kalpana*, the preparation of medicated ghee (*ghrita*) and oils (*taila*) by cooking a herbal paste (*kalka*) and liquid (*drava*) with a fat until defined end-points are reached, is one of the most important dosage forms of Ayurveda. It is often described as an ancient lipid-based drug delivery system. **Objective:** To examine the scientific basis for describing *Sneha kalpana* as a lipid-based delivery system, and the evidence that it improves the bioavailability or activity of herbal constituents. **Methods:** A critical narrative review of classical process descriptions, analytical and pharmacological studies of *ghrita* and *taila*, and the modern literature on lipid-based formulations. **Results:** The classical ratio of one part *kalka*, four parts fat and sixteen parts liquid, with defined stages of cooking (*mridu*, *madhyama*, *khara paka*), creates conditions for extraction of both lipophilic and some hydrophilic constituents into the fat. Ghee is about 98% lipid, mainly triglycerides, with small amounts of mono- and diglycerides. Digestion of such lipids forms mixed micelles that can solubilise lipophilic compounds and promote lymphatic transport. Comparative studies show that *ghrita* forms can be more active than aqueous forms, for example *Guduchi ghrita* compared with fresh juice in rats; however, direct pharmacokinetic comparisons of *ghrita* or *taila* with other dosage forms are rare. **Conclusion:** The lipid-delivery hypothesis is scientifically plausible and partly supported, but it needs pharmacokinetic studies using marker compounds and classification of *Sneha kalpana* within modern lipid formulation frameworks.

**KEYWORDS:** *Sneha kalpana*; *Ghrita*; *Taila*; Lipid-based drug delivery; Bioavailability; Lymphatic transport; *Murchhana*

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## INTRODUCTION

Fats and oils (*sneha*) have a special place in Ayurveda, both as medicines in their own right and as vehicles. *Sneha kalpana*, the preparation of medicated *ghrita* and *taila*, is described in detail in classical texts, most systematically in the *Sharangadhara Samhita*[1]. A herbal paste (*kalka*), a fat (*sneha*) and a liquid (*drava*), commonly a decoction, juice, milk or water, are cooked together over a low, steady fire until the water has evaporated and defined signs of completion appear. The product is used orally, for *nasya* (nasal administration), *basti* (enema) and external application.

Over the past two decades, *Sneha kalpana* has been compared with modern lipid-based drug delivery systems, including liposomes, emulsions and solid lipid nanoparticles[2,3]. These comparisons are attractive because many active plant constituents are poorly water-soluble and poorly absorbed, and lipid formulations are a recognised strategy for improving their oral delivery[4,5]. This review examines how far the comparison is supported by evidence.

## 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 *Sneha kalpana*, *ghrita*, *taila*, medicated ghee, medicated oil, *murchhana*, lipid-based drug delivery, bioavailability and lymphatic transport. Classical process descriptions, analytical and pharmacological studies of *Sneha kalpana*, and established literature on lipid formulations were included.

## THE CLASSICAL PROCESS

### 1. Ratios and stages

The general rule is one part *kalka*, four parts *sneha* and sixteen parts *drava*, with the proportion of *kalka* adjusted according to the type of liquid[1,2]. Cooking proceeds through recognisable stages. In *mridu paka*, the *kalka* is soft and still contains traces of water; in *madhyama paka*, it can be rolled into a wick without sticking and the fat no longer crackles; in *khara paka*, the *kalka* is hard and dry. The stage chosen depends on the intended route: *mridu paka* for *nasya*, *madhyama paka* for oral use and *basti*, and *khara paka* for external application. Over-cooking (*dagdha paka*) is considered to destroy the medicine[6].

### 2. Pre-treatment of the fat

Classical texts prescribe *murchhana*, a pre-treatment of ghee or oil with specified herbs, to remove unpleasant odour and improve the fat's suitability as a vehicle. Comparative analyses of plain and *murchhita ghrita* have reported differences in physicochemical parameters[7].

### 3. What happens chemically

From a modern standpoint, *Sneha kalpana* combines three operations. First, the hot aqueous phase extracts water-soluble constituents from the *kalka*. Second, as water evaporates, constituents partition between the shrinking aqueous phase, the plant matrix and the fat, so that lipophilic compounds are concentrated in the fat. Third, prolonged heating may transform some constituents and drives off water to give a stable, low-moisture product. Studies comparing medicated oils prepared by the classical and modified processes have found differences in composition, indicating that the process itself, not only the ingredients, determines the product[8].

## GHEE AND OILS AS LIPID VEHICLES

Ghee consists of about 98% lipid, with triglycerides making up about 98% of the lipid fraction, diglycerides 1–2% and monoglycerides 0.1–0.2%; saturated fatty acids account for roughly half of the fatty acids[3]. Sesame oil, the most common base for *taila*, is rich in unsaturated fatty acids. In modern terms, these are long-chain triglyceride vehicles.

**Table 1. Comparison of *Sneha kalpana* with modern lipid-based formulations**

| Feature | *Sneha kalpana* (*ghrita*, *taila*) | Modern lipid-based formulations |
|---|---|---|
| Lipid | Ghee, sesame or other oils (long-chain triglycerides) | Defined triglycerides, mixed glycerides, surfactants and co-solvents |
| Drug loading | Extraction of plant constituents during cooking | Dissolution of a defined drug in the vehicle |
| Composition control | Process-defined; content of actives rarely measured | Quantitatively defined |
| Dispersion in gut | Relies on digestion by lipases and bile | Ranges from digestion-dependent (Type I) to self-emulsifying systems |

| | | |
|---|---|---|
| Classification | Not classified | Lipid formulation classification system |
| Evidence | Mainly pharmacological comparisons | Pharmacokinetic studies and regulatory approval |

The lipid formulation classification system groups formulations from simple oils that depend on digestion (Type I) to self-emulsifying systems with surfactants (Types II–IV)[9]. Plain *ghrita* and *taila* correspond to Type I systems: they require digestion by gastric and pancreatic lipases and emulsification by bile to release their contents. Digestion produces mono- and diglycerides and fatty acids that, with bile salts and phospholipids, form mixed micelles capable of solubilising lipophilic compounds[3,4]. Long-chain triglycerides can also promote assembly of chylomicrons in enterocytes and lymphatic transport of highly lipophilic compounds, bypassing first-pass hepatic metabolism[10].

## EVIDENCE THAT SNEHA KALPANA IMPROVES DELIVERY OR ACTIVITY

**Table 2. Selected evidence relevant to *Sneha kalpana* as a delivery system**

| Study | Design | Main findings |
|---|---|---|
| *Guduchi ghrita* vs fresh juice (*swarasa*) | Three *ghrita* samples compared with fresh stem juice for adaptogenic activity in rats | *Ghrita* forms gave the better effect |
| *Brahmi ghrita* | CNS activity in animals | CNS activity of the *ghrita* evaluated |
| Medicated oils | Classical vs modified process | Composition differed with process |
| Plain vs *murchhita ghrita* | Physicochemical comparison | Pre-treatment altered physicochemical parameters |

### 1. Pharmacological comparisons

In a comparison of three samples of *Guduchi ghrita* with fresh juice of *Tinospora cordifolia*, the *ghrita* forms gave the better adaptogenic effect in rats[11]. *Brahmi ghrita* has shown CNS activity in animals[12]. These studies support the classical preference for *ghrita* in certain indications, but they compare different products rather than measuring absorption, and they cannot separate the effect of the vehicle from that of ghee itself or of processing.

### 2. Lipophilic constituents

Many constituents of plants used in *ghrita* are lipophilic and poorly absorbed from aqueous forms. Curcumin is a well-known example: its oral bioavailability is very low, and lipid-based formulations are among the strategies used to improve it[5,13]. Turmeric, along with other herbs containing lipophilic actives such as *Bacopa*, *Withania* and *Piper* species, is common in *Sneha kalpana*. The theoretical case for improved delivery of such constituents is therefore strong.

### 3. What is missing

Despite this, direct pharmacokinetic studies comparing *ghrita* or *taila* with aqueous or powder forms of the same herbs, using defined marker compounds, are rare. Without them, the claim that *Sneha kalpana* improves bioavailability remains a well-founded hypothesis rather than an established fact[2]. Studies are also needed on the fate of hydrophilic constituents, which may be poorly retained in the fat or lost with evaporated water.

## LESSONS FROM MODERN LIPID FORMULATION SCIENCE

Modern lipid formulation research offers several lessons for *Sneha kalpana*[4,14,15]:

- **Characterise the vehicle and the load.** Fatty acid profile, mono- and diglyceride content and the concentration of marker constituents should be measured.
- **Test digestion.** In vitro lipolysis models can show how constituents are distributed between oil, micelles and precipitate during digestion.
- **Consider dose of fat.** Classical oral doses of *ghrita* can be large; the amount of fat influences gastric emptying, bile secretion and lymphatic transport.
- **Account for food effects.** Many classical regimens specify timing relative to food; the presence of dietary fat alters absorption of lipophilic compounds.

## QUALITY AND STABILITY

*Sneha kalpana* products are susceptible to oxidative rancidity and hydrolysis. Their stability depends on residual moisture, the fatty acid profile, antioxidants contributed by the herbs, and storage. Classical end-points are designed to remove water and are therefore relevant to stability. Peroxide value, acid value, moisture content and marker assays should be part of

routine quality control, and shelf-life studies under defined conditions are needed for each product.

## RESEARCH GAPS

The main gaps are: pharmacokinetic comparisons of *ghrita* or *taila* with aqueous and powder forms of the same herbs; in vitro lipolysis studies of classical preparations; quantification of how hydrophilic constituents behave during cooking; studies of lymphatic uptake; and studies on the effect of the *paka* stage on composition and activity.

## CONCLUSION

*Sneha kalpana* combines extraction and formulation in a single process and produces long-chain triglyceride vehicles that are, in modern terms, Type I lipid formulations. The physiology of lipid digestion and the lipophilicity of many herbal actives make the claim that *ghrita* and *taila* enhance delivery scientifically plausible, and some pharmacological comparisons support it. Direct pharmacokinetic evidence is, however, still lacking. Studies combining classical process control, marker assays, in vitro lipolysis and pharmacokinetics would allow *Sneha kalpana* to be described as a lipid-based delivery system on firm evidence.

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