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**Lipid Based Drug Delivery System in Ayurveda - An Overview**Krishna Rao.S<sup>1\*</sup>, Indu.S.<sup>2</sup>, and Pradeep Kumar P.P.<sup>3</sup><sup>1-3</sup>National Avurveda Research Institute for Panchakarma, Thrissur, Kerala, India**ABSTRACT**

Lipids and lipid-based formulations (*Snehās*) are commonly used in curative as well as preventive aspects in Ayurveda. They are used as food, medicine, vehicle etc. The present review highlights the importance and superiority of unique lipid-based formulations (*Sneha kalpanas*) from an Ayurvedic and modern perspective. All the important literature from both modern medicine and Ayurveda along with online sources were searched and analysed. In Ayurveda lipids are used alone and/or in processed formulations both internally and externally. It is used to extract lipophilic components and facilitate its delivery to deeper tissues and has the potential to bypass blood brain barrier and placenta that are non-permeable to hydrophilic components. The lipid-based drug delivery system is superior when compared to aqueous based preparation with respect to absorbability, bioavailability, shelf life, safety, efficacy, and multiplicity in route of administration like oral, parenteral, ocular, intranasal, dermal/ transdermal, transcranial, transplacental and vaginal, abundance in availability. Due to these attributes, Ayurveda classics used ghee, oil and other milk-based formulations in infants, old age, and psychiatric as well as chronic degenerative diseases.

**KEYWORDS**

*Lipid based formulations; Ayurveda; Sneha Kalpana, Bio availability*

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## INTRODUCTION

*Ayurveda* -The science of life considers everything in this world as medicine<sup>1</sup>. In *Ayurveda* all *dravyas* (drugs/substances) are used either as *ahara* (food) or as *aushadha* (medicine). Among the *dravyas*, *sneha* (lipids) is the most important one, which is judiciously used both as a food as well as a medicine. The wide utility of *Sneha* is due to the better pharmacokinetic action when compared to other dosage forms because of the lipid nature of bio membranes of our body. According to *Ayurveda* man is the essence of *sneha* itself<sup>2</sup>, because among the seven *dhathus* (tissues) of the body six has inherent quality *snigdhatva* (unctuousness), so this *sneha* attribute should be nourished on a regular basis. Starting from *dinacharya* (daily regimens), *rithucharya* (seasonal regimen) itself *Ayurveda* has emphasised the use of various types of lipids for different internal as well as external, therapeutic as well as preventive purposes, and also as food itself. In treatment aspects also, the lipid based formulations, mainly *ghrtha* (ghee), and *taila* (edible oils) are used for the preparation of different dosage forms falling under “*Sneha Kalpana*”<sup>3</sup>. *Sneha Kalpana/paka* may be defined as “A pharmaceutical process to prepare oleaginous medicaments from the substances like *Kalka* (herbal paste of

different parts of botanicals), *Kwatha* (specifically prepared decoction in accordance of *Ayurvedic* principles) or *Drava Dravya* (any other liquid such as milk, self-expressed juices, meat juice, etc.) taken in specific proportion and by subjecting them to unique heating pattern and duration to fulfil certain pharmaceutical parameters, according to the need of therapeutics”<sup>4</sup>. This process ensures that the active botanical ingredients are transferred into the oil base<sup>5,6</sup>.

Lipid-based drug delivery systems (LBDDS) are designed to address challenges like the solubility and bioavailability of poorly water-soluble drugs<sup>7</sup>. These formulations can be personalised to meet a wide range of product requirements based on disease indication, route of administration, cost consideration, product stability and efficacy. Lipid-based formulations reduce the toxicity of drugs by changing the bio distribution of the drug away from sensitive organs, higher degree of biocompatibility and versatility. Routes like oral, parenteral, ocular, intranasal, dermal/ transdermal, and vaginal can be used for the administration of the LBDDS<sup>8,9</sup>. However, oral route is the most preferred route because of the properties



like non-invasiveness, less expensive, less prone to side effects, the easiest and the most convenient method of drug delivery for the management of chronic diseases and long-term medication.

## MATERIALS AND METHODS

A thorough search was done in Ayurveda classics, conventional modern books and in database of Google scholar, PubMed, NCBI for getting relevant authentic data from literatures and research publications. Mostly articles published in English language were considered for review.

## DISCUSSION

### Role of *Sneha* /Functional lipids

Fats and lipids are common components of food and may perform essential roles. Foods can be regarded as functional if they help in reducing the risk of disease and promote good health. The objective of this review is to summarize the information on the role of *sneha*-functional lipids, on human health and the scientific basis behind the use of the same. New research has linked functional lipids for the prevention and treatment of many diseases. Scientific evidence has shown encouraging improvements in patients and beneficial effects in healthy persons with the use of supplemental and dietary forms of functional lipids. Although there is no

authoritative definition of functional lipids, one can informally define them as a subset of functional foods, which are similar in appearance to conventional foods consumed as part of a usual diet, but they have been demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions<sup>10</sup>

Thus *Sneha Kalpana/paka* is a unique dosage form in Ayurveda aiming mass transfer of the aqueous and lipid-soluble active principles of all treated herbal drugs and material of animal and mineral origin, if any, in accordance of established formulae quoted in authoritative text books which should serve therapeutic objectives as per indications of the classical texts<sup>11</sup>. Ayurveda has mentioned about number of *snehas* from plant (**Table:1**) and animal sources.

Fish, quadrupeds, and birds constitute the sources of animal fat<sup>12</sup>. Curd, milk, ghee, meat fat and bone marrow of animals are used as *sneha dravyas*. Among them *sarpis*, *thaila*, *vasa* and *majja* are considered as superior four, and *sarpis* the best among all due to the unique property *samskarasyaanuvartana*<sup>13</sup>. Therapeutically, among these four *snehas*, *sarpis* and *thaila* (especially *tilathaila*-



sesame oil) are the ones that are widely used.

**Table 1** List of vegetable sources of oils<sup>48</sup>

Sl:No	Vegetable source of Oil	Latin name
1	<i>Tila</i>	Sesamum indicum
2	<i>Priyala</i>	Buchanania lanzan
3	<i>Abhisuka</i>	Pisatace avera
4	<i>Vibhithaki</i>	Terminalia belerica
5	<i>Citra</i>	Baliopermam montanum
6	<i>Abhaya</i>	Terminalia chebula
7	<i>Eranda</i>	Ricinus communis
8	<i>Madhuka</i>	Madhuca indica
9	<i>Sarshapa</i>	Brassica nigra
10	<i>Kusumbha</i>	Cartham tinctorious
11	<i>Bilva</i>	Aegle marmelos
12	<i>Aruka</i>	Prunus persica
13	<i>Mulaka</i>	Raphanus sativus
14	<i>Atasi</i>	Linumu sitatissimum.
15	<i>Nikocaka</i>	Artocarpus lakoocha
16	<i>Aksoda</i>	Alleurites moluccana
17	<i>Karanja</i>	Pongamia pinnata
18	<i>Sigruka</i>	Moringa oleifera

They are used individually or in combination of two (*yamaka*), three (*trivrit*) or all four (*maha Sneha*)<sup>14</sup>. Based on disease Ayurveda uses *sneha* in wide spectrum of physiological as well as pathological conditions. On therapeutic utility basis, *snehana* is basically classified into two – *Abhyanthara Snehana* (Internal oleation) and *Bahyasnehana* (external oleation).

#### **Abhyantaranehana:**

This process is also known as *snehapana* ie: consumption of any type of *sneha* (medicated /non medicated) in a specified quantity on the basis of *agni* (digestive fire), *kosta* (nature of the alimentary tract), *vyadhi*(disease), *prakruthi* (constitution), *vayas*(age) etc. It is classified into *Achapanana* and *vicharana snehapana*. If it is not mixed with any of the food item or medicinal preparation it is called as

*Achapanana*<sup>15</sup>, usually done for lubrication and softening of internal tissues as a preparatory procedure for various *sodhana karmas*(purification therapies). It is generally administered in a higher dose in a systematically increasing manner. *Vicharanasneha*<sup>16</sup> is the consumption of *Sneha* in combination with other medicines or food, usually in a lower dose. This can also be administered through rectal route (*snehavasthi*) and nasal route (*nasya*) and other external pathway also. The 24 types of *vicharana snehana* mentioned by *Acharya Charaka* is listed below **Table 2**.

#### **Bahyasnehana:**

It refers to the different modes of external uses of *sneha*, which is a form of *vicharanasnehana* itself. It is performed in the form of *abhyanga*; a simple method of administration involves application of



**Table 2** 24 types of Vicharana sneha<sup>49</sup>

Sl :No	Type of Vicharana sneha
1	<i>Odana</i> ( Cooked rice)
2	<i>Vilepi</i> (Gruel prepared using rice and water, it has more solid and less quantity of water)
3	<i>Rasa</i> (Meat Soup)
4	<i>Mamsa</i> (Meat)
5	<i>Payas</i> (Milk)
6	<i>Dadhi</i> (Curd)
7	<i>Yavagu</i> ( Gruel preparation with more solid content)
8	<i>Soopa</i> (Soup prepared of vegetables, pulses etc)
9	<i>Shaka</i> (Processed vegetables)
10	<i>Yusha</i> (Soup prepared of green gram, butter milk and other herbal medicines)
11	<i>Kambalika</i> (Sour milk mixed with vinegar)
12	<i>Khada</i> (Butter milk processed with vegetables and spices)
13	<i>Sakthu</i> (Roasted flour)
14	<i>Thila pista</i> (Sesame paste)
15	<i>Madya</i> (Fermented preparations)
16	<i>Lehya</i> (Linctus)
17	<i>Bhakshya anna</i> (As food items)
18	<i>Abhyanga</i> (Massage)
19	<i>Gandusha</i> (Gargles)
20	<i>Karnapoorana</i> (Instillatin of ear with Sneha)
21	<i>Nasa tharpana</i> (Nasal instillation of Sneha)
22	<i>Akshi tarpana</i> (Pooling of sneha around eye)
23	<i>Vasti</i> (Enema)
24	<i>Uthara vasti</i> (Vaginal or Urethral enema)

the medicated oil on the body and massaging the areas with gentle or deep hand strokes), Dhara (gentle pouring of the medicated oil on the in a continuous stream), *Pichu* (keeping a cloth soaked in oil/any *Sneha*), *tharpana* (process of giving *snehana* to eyes using lipids like ghee.oil)etc. Anything hot and warm when applied on the skin will immediately cause capillary dilatation. Same principle applies to external procedures like *abhyanga* are done on the body. *Acharya* Susruta has explained the mode of action of these external procedures, where the *virya* (potency) of the drugs present in *abhyanga*, *seka*, *lepa* and other external therapies are absorbed into the skin and are

then digested by the component of Agni i.e, *Bhrajaka pitta*(digestive component of agni present in skin). Susruta in another context has also mentioned that the *Sneha* used in *avagahana* nourishes the body through *siramukha* (opening of the veins), *romakupa*(root of hair follicles) and *dhamani* (arteries) .This can be the mode of action of all *bahyasnehana* procedures used in Ayurveda.

#### **Use of Sneha for maintaining health & prevention:**

- *Acharyas* has mentioned ghee as one among the food items that should be practised regularly<sup>17</sup>.
- ***Thaila nasya*** :( Nasal medication in the form of oil):It helps in prevention of



diseases related to head and neck, premature ageing also does not affect the head. *Ayurveda* advises the use of *Anuthaila* daily as a part of daily regimen. It is useful in pacifying of all the three *dosas* (Humours) and strengthening all the sense organs<sup>18</sup>.

- ***Siroabhyanga* :( Applying oil on head):** Daily application of oil prevents baldness, headache, premature greying, and hair fall. It strengthens the head and forehead, promotes black, strong and deep rooted hairs, aids the proper functioning of sense organs, improves the skin texture and aids in sound sleep<sup>19</sup>.

- ***Karnapoorana*:** Prevents diseases of ear due to *vatadosha*, conditions like torticollis, lockjaw, hardness of hearing and deafness<sup>20</sup>.

- ***Thila abhyanga* (Oil massage):** By regular oil massage the body becomes strong, resistant, and smooth skinned. The body becomes non-susceptible to diseases of *vatadosha* and is resistant to exhaustions and exertions<sup>21</sup>.

#### ***Sneha* as a medium for drug transport:**

*Snehas* especially oil and ghee serve as a base for preparing wide range of *Ayurvedic* drugs. The ability to reach the deepest tissue in the body and the multiple modes of utility makes it ideal for preparing medicines that are organ /tissue specific. *Snehas* like *ghrtha* and *thaila* are

traditionally used as *anupana* (vehicle) for many *kashaya* (decoction), *choorna yogas* (powder preparations). *Snehas*, especially *ghrta*, *navaneeta*, *ksheera* (milk), *mamsa rasa* (meat soup) are generally one among the preferred medium of preparation and transport in those having tender constitution, for children and old people<sup>22</sup>. In infants usually while giving *lehana* and *prasana*<sup>23</sup> these are usually the preferred medium due to mild potency, palatability and facilitates easy absorption. While administering the *Medhyarasayanas*<sup>24</sup> (drugs that stimulate the CNS) also the lipid based medium like *ksheera*, *ghrtha* selected as the suitable vehicle.

#### **REASONS FOR SUPERIORITY OF SNEHA IN DIFFERENT ROUTES OF ADMINISTRATION:**

##### **In Gastro Intestinal tract :**

Absorption in the gastro intestinal tracts depends on lipid solubility, degree of ionisation and molecular weight of the drug<sup>25</sup>. Lipid soluble drugs are normally absorbed easily. To reduce toxicity, acceptability and absorbability pharmaceutical industries are now depending on newer forms of drug delivery system like liposome<sup>26</sup> (encapsulation within a lipid vesicle). This increases the safety profile and allows the use of higher dosage of the drugs.



### **In Topical routes:**

The rates of absorption of topically applied drugs depend on concentration, lipid solubility and local blood flow<sup>27</sup>. This principle is applicable to all the external oleation therapies like massage, nasal medications etc. Significant brain functional activation changes together with increased cerebral blood flow were observed in participants who received a massage. Massage reduced the levels of stress-related serum cortisol, arginine vasopressin, and salivary stress protein chromogranin A with concomitant increases in circulating lymphocytes and regional cerebral blood flow<sup>28-31</sup>

In addition to the above-mentioned hormonal changes, a gentle oil massage could relax the tight junctions between endothelial cells in the CNS vessels and facilitate the entry of solutes and other components into the CNS. Ayurveda also relies on several transcranial oleation therapies for nervous system disorders that are non-systemic and non-invasive. Procedures like *Shirodhara* (gentle pouring of the medicated oil on the forehead in a continuous stream), *Shirobasti* (a special leather cap is placed over the shaved head of a patient and medicated oil is poured and retained over the head for stipulated time period), *Shiroabhyanga* (medicated oil is smeared

on the head followed by a gentle massage) may also influence hormonal and cerebral blood flow levels to a degree similar to that of Ayurvedic massage as mentioned above<sup>32-25</sup>.

### **In Parenteral route:**

Parenteral route is usually selected when rapid action is desired. Local vascularity of the areas influences the absorption from the site. Aqueous formulations are absorbed rapidly, while the oil-based preparations are absorbed only slowly<sup>36</sup>. Local warmth and massage also favours the rate of absorption. This principle is the principle behind the action of different types of oil enema where the retention time and efficacy are directly proportional to each other. Ayurveda make use of this principle in procedures like *matravasti* (oil enema) where in nutritive and curative is achieved based on the condition and disease of the individual.

### **Superiority of Lipids in CNS disorders:**

The easy entry depends on lipid solubility and concentration gradient across the cell membrane. Some of the specialised tissues like Central Nervous system (CNS) take-up drugs selectively i.e.: most tissues of CNS restrict the entry of polar (ionised) compounds. Lipid soluble substances enter easily down a gradient across the blood brain barrier<sup>37</sup>. Ayurveda relies on some novel methods of administering herbs or





their preparations (or both) to treat CNS disorders. However, proper studies are lacking to demonstrate whether these herbs or their components given orally or by some other means cross the BBB and reach the CNS. One novel method of herbal delivery, called 'Nasya', which involves intranasal delivery of dry herbal powders or medicated oils and is a practical, non-invasive, rapid, and simple method to deliver the therapeutic agents into the CNS. The lipid based preparations ensures the transport of lipophilic and lipid-soluble molecules across the BBB membrane, where hydrophilic compounds demonstrate minimal permeation<sup>38</sup>. Intranasal administration offers numerous benefits for drug delivery into the CNS. The delivery is rapid, bypasses the BBB, and directly targets the CNS, thereby reducing systemic exposure and side effects<sup>39-43</sup>.

In Ayurveda in the management of Neurological as well as psychological disorders the use of preparations made in/through ghee is of prime importance. Its utility can be clearly seen in *chikitsa* of *Vatavyadhi* (degenerative disease caused by derangement of vatadosha), *Apasmara* (Epilepsy), *Unmada* (Psychiatric disorders) etc. While scientific studies regarding the permeation of the herbal components into the CNS through transcranial oleation

therapies are lacking. Recent work again points to the possibility that the endothelial cells facilitate the entry of the solutes through the frontal lobe and prefrontal cortex<sup>44,45</sup>

#### **In Transplacental transfer:**

The placenta behaves like a selective barrier in the body and protects the foetus. Lipid soluble drugs of molecular weight lower than 1000 diffuses freely across the placenta from the maternal to foetal circulation, while water soluble ones diffuse only slowly<sup>46</sup>. In *Ayurveda* classics while explaining *garbhiniparicahrya* (prenatal care), all the *Acharyas* has given importance to preparation/vehicle in the form of lipids medium like *ghrtha*, *navaneetha* (butter), milk<sup>47</sup> etc.

#### **CONCLUSION**

- The advantages of Lipids and lipid-based drug delivery system is extensively practised in *Ayurveda* for maintenance of health as well as curing of disease.
- Lipids and lipid-based formulations are used in wide range, different dosage forms both externally and internally in managing Chronic diseases.
- The Lipid based drug delivery system has many advantages over other bases of drug delivery. It enhances the shelf life, bioavailability, absorbability,



safety profile and permeability of drugs over hydrophilic drugs.

- It can be used as a effectively in drug delivery to deeper structures inside blood brain barrier, placenta thereby facilitating the entry of active principles of the formulations into brain and foetus.
- The Qualitatively and Quantitatively monitored use of lipids will safeguard the health and improve immunity of the body.



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