

Nano Technology and Targeted Drug Delivery System : Phytosomes in Herbal Medicine

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ABSTRACT

Herb drugs have a variety of phytochemical components, most of flavonoids and terpenoids are among the most widely used compounds. Phytosomes represent a promising advancement in the field of herbal medicine and natural products, offering enhanced bioavailability, targeted delivery, and improved therapeutic outcomes. Despite challenges such as production costs and standardization issues, their proven efficacy and safety make them valuable for pharmaceutical, nutraceutical, and cosmeceutical applications. Continued research and innovation will further refine phytosome technology and expand its use in diverse therapeutic areas. A unique medication delivery dosage form is called a phytosome. Phytosomes is a technology that is patented. It is employed in the formulation of medications to increase the phytoconstituents' bioavailability that are found in herbal preparations or extracts between phospholipids and phytoconstituents. Nowadays, the pharmaceutical business values phytosomes the most as a research arena. Students and industry scholars can benefit from this as well. We also discuss the many beneficial properties of phytosomes, advantages of their preparation process, characterization of some marketed products and future advances.

KEY WORD: Phytosomes, herbal medicine, herbal extract, phospholipid, bioavailability.

I. INTRODUCTION

Herbal medicines have been used throughout history since ancient times. As a result of their lower side effects, herbal remedies are recognized by doctors and patients to provide superior therapeutic efficacy compared to conventional drugs. A scientific strategy must be developed for the administration of phytotherapeutics over an extended amount of duration within order to improve patients' compliance and

reduce need for recurrent administration. An innovative way of delivering herbal components is by means of cutting-edge drug delivery technologies (NDDS). In addition to reducing toxicity and increasing bioavailability, NDDS also contributes to improving the therapeutic value of the drug by reducing the need to administer the drug more frequently to overcome non-compliance. The use of nanotechnology is an example of an innovative strategy. In the future, natural remedies may benefit from the use of nanoscale drug delivery systems in order to increase their effectiveness and solve issues associated with them[1].

Over 80 percent of the global population is reported to use herbal medicines, based on the World Health Organization's guidelines. The word "some" used to describe anything that resembles a cell, whereas the word "phyto" refers to a plant. Herbosomes is the alternative word for it. Using this novel, patented method, phospholipids are combined with aqueous phytocomponents or systematic herbal extracts to create lipid-consistent, nanoscale composites that greatly improve absorption and bioavailability. [2] It might be feasible to improve poor bioavailability plant constituents' miscibility in lipid-rich hurdles by using an emerging nanotechnology, phytosomes. Targeted distribution of phytoconstituents to the site of action is achieved through the use of several innovative drug delivery vehicles. Plant proteins were widely recognized as nontoxic nanocarriers which can be employed in numerous innovative drug delivery systems (NDDS) to improve the absorption and absorption of drugs derived from plants. [3] Plant proteins can be utilized to treat chronic liver illnesses and infectious diseases because of their strong medicinal and physicochemical qualities. It may also be utilized in medicinal and cosmetic compositions, as well as as an anti-inflammatory[4].

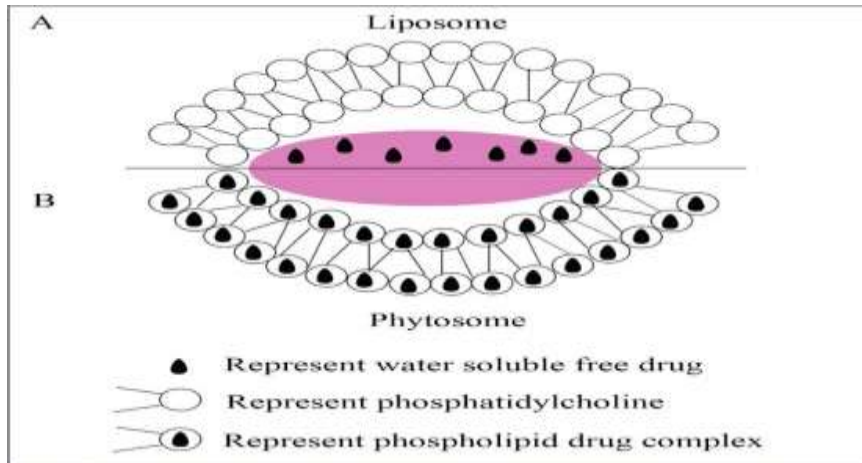


Figure :1Phytosomes used for Herbal Drug Delivery

Advantages

- Because of their improved absorption, phytosomes have the advantage of being more bioavailable than ordinary plant extracts.
- Due to increased absorption, it is necessary to reduce the dosage of phytoconstituents to provide biological effects.
- The enhanced stability and trapping effectiveness of phytosomes can be attributed to the chemical bonds that form between phospholipid molecules and bioactive chemicals. Ensuring appropriate medication distribution to the intended tissues is ensured.
- Because phytophospholipid complexes have a higher lipid profile and improved skin penetration, which both encourage the absorption of bioactive phytochemicals via the skin, cosmetics employ them extensively.
- The solubility of phytosomes in aqueous media is comparatively low, which promotes the creation of stable emulsions or creams.
- The rate at which drugs compound with phytosomes is higher, and the process of manufacturing phytosomes is not a complex process.[5]



Figure :2 Advantages of Phytosomes

Disadvantage

- Even though phytosomal products have several advantages as a medication delivery mechanism, they are not widely available in the market.

- Its manufacture is expensive, and allergic responses to the phytosomal constituents are occasionally reported.
- It has a short half-life.
- Phospholipid molecules undergo oxidation, fusion, hydrolysis, and leakage.[5]

Table : 1 The variation between liposomes and phytosomes

SR.NO	PROPERTIES	PHYTOSOME	LIPOSOME	REFERENC ES
1.	Attachment	Binding to a small number of molecules, particularly phospholipids and polyphenol extract	Even among the numerous molecules, there is a lack of connectivity.	[6]
2.	Oral medication	Good for oral medication	A limited oral bioavailability that was well-connected	[7]
3.	Ratio of phospholipids	Phospholipid ratio are preferred 1:1, 1:2 ratio for their formation.	The amount of fat consumed is ten times greater than the primary active ingredient.	[8]

Properties of Phytosomes

Physical properties

- The lipophilic substances that make up a herbosome have distinct melting points.
- Phytosomes generate micellar structures resembling liposomes when they come into touch with water [9].

Chemical properties

- The functional group of water-soluble substrates forms a compound called phospholipid polar head and ribosomes [10].
- Between the polar surfaces of the phospholipid and the substrate, they created hydrogen bonds [11].
- When exposed to water, herbosomes form liposomes that resemble micelles [12].

Genetic characteristics

- Emerging structures known as phytosomes are extensively utilized and digested. As a result, they perform better in terms of bioavailability and outcome quality than ordinary natural herbs and straightforward extracts that have been used in drug studies on humans and animals.
- To classify their activity in physical or biological systems, phytosomes use a range of factors, such as material quantity and purity, chemical composition, percentage of capture, membrane porosity, and physical size [13].

Physio-chemical properties

- Reacting phytoconstituents in an aprotic solvent with a stoichiometric quantity of phospholipid can result in the formation of phytosomes.
- Phytosomes can vary in size from 50 nm to several hundred μm.[14]

Part of Phyto-Phospholipids

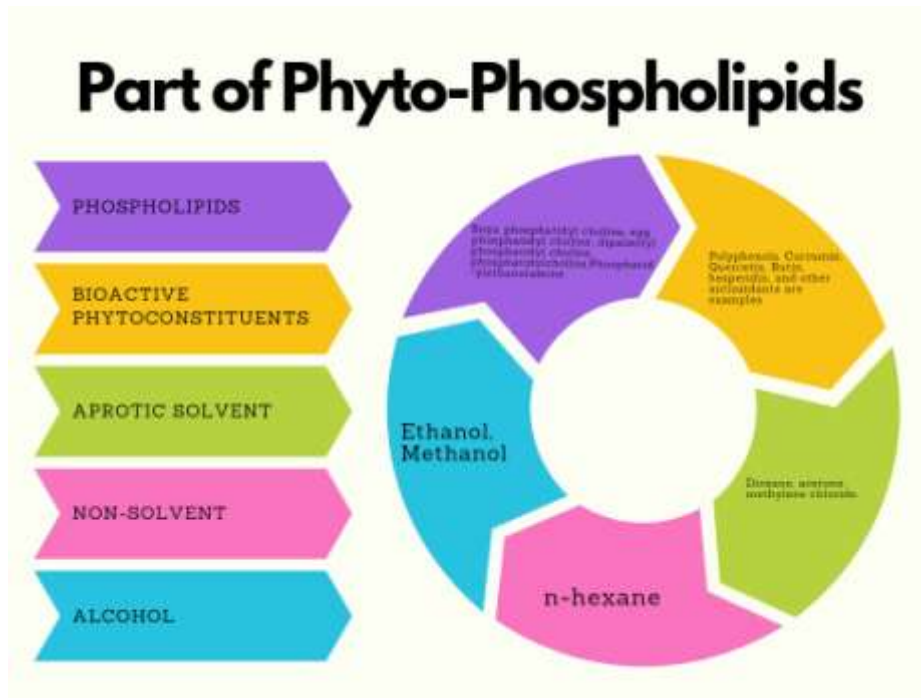


Figure : 3 Part of Phyto-Phospholipids [15-17]

Methods of Preparation Phytosomes

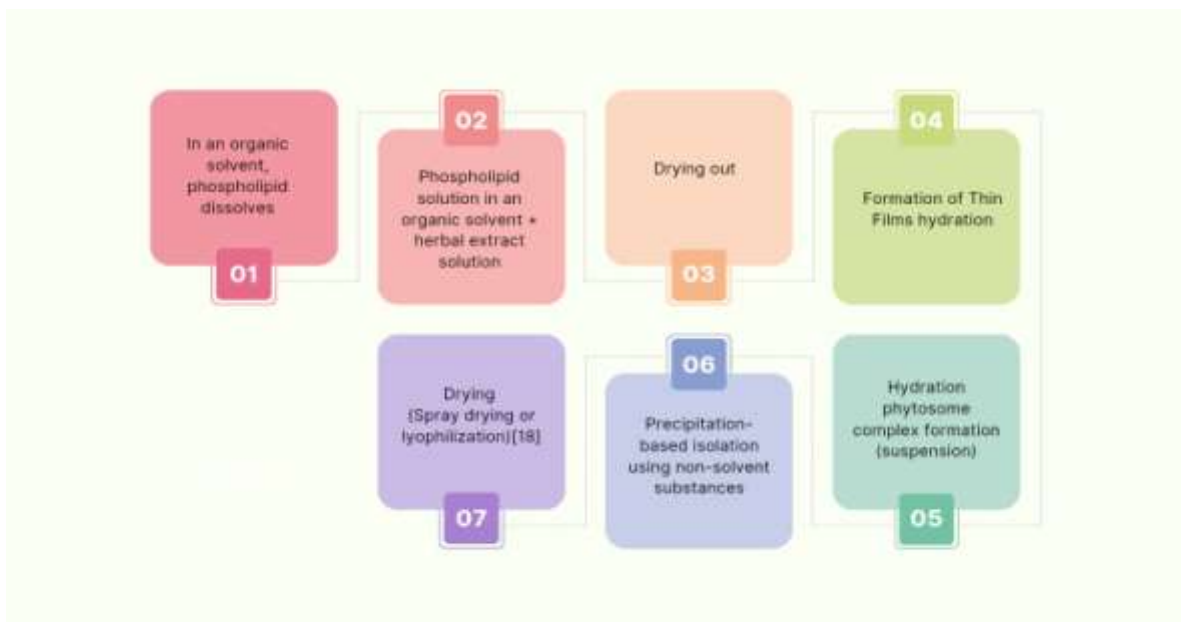


Figure : 4 Preparation Phytosomes[18]

Solvent Evaporation Method

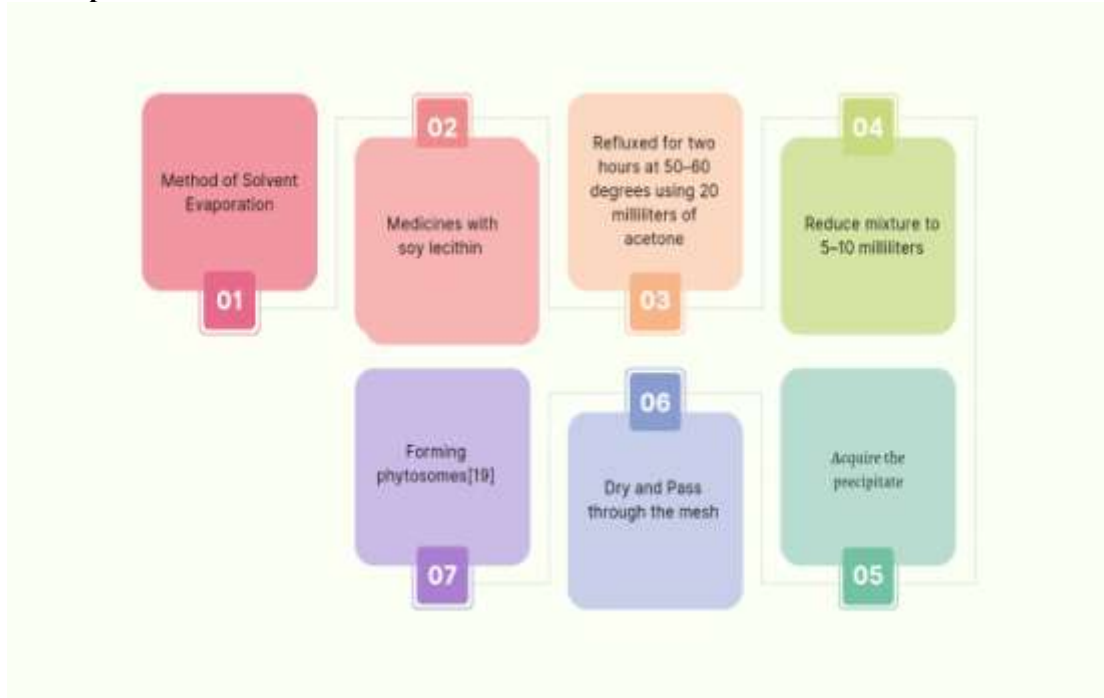


Figure : 5 Solvent Evaporation Method[19]

Anti-solvent Precipitation Technique



Figure : 6 Anti-solvent Precipitation Technique[20]

Rotary Evaporation Technique

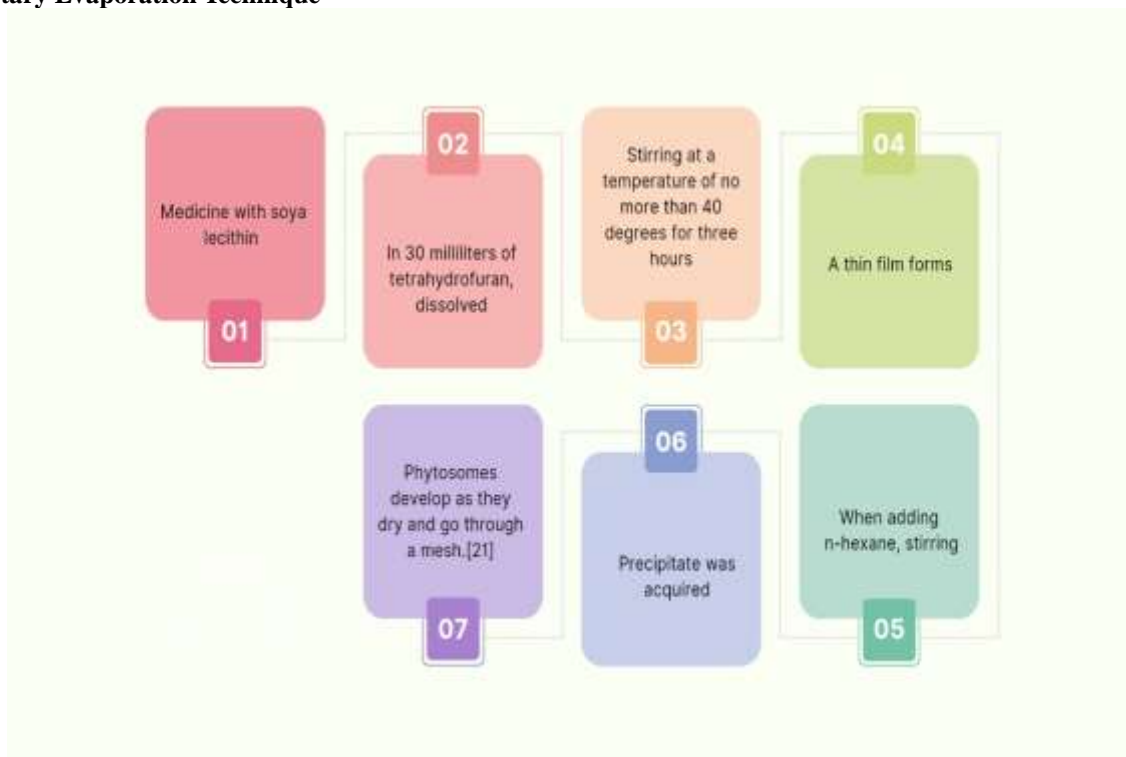


Figure : 7 Rotary Evaporation Technique[21]

Characterization of phytosomes

Physical properties of phytosomes

Particle Size- Particle size can be measured using zeta potential, dynamic light scattering (DLS), and photon correlation spectroscopy. Typically, particle sizes range from 50 nm to 100 µm. [22]

Shape-To observe and describe the morphology of phytosomal products, Shape-TEM and SEM were used. [23]

Membrane permeability and surface tension- Membrane permeability and surface tension can be measured using a Franz diffusion cell and a Du Novy ring tensiometer. [24]

Percentage of drug release-The drug release percentage is calculated using high-performance liquid chromatography, or HPLC.

Entrapment efficiency-Ultra centrifugation technology is used to calculate the efficiency of traps. The product rotates for 30 minutes in a centrifuge set at 18000 rpm. [25]

Spectroscopic evaluation of phytosomes- Different spectroscopic methods are employed for determining the relationship between phospholipids and herbal components: -

H1 NMR and 13C-NMR

To precisely identify complex compounds and proteins and offer structural information. The original fatty acid chain is preserved, but signals corresponding to the lipids' glycol and choleic acid components are extended between 60 and 80 ppm. [26]

FTIR

FTIR, is used to evaluate the stability of products. [27]

Biological testing of phytosomes

Analysis both in vivo and in vitro

The process of choosing samples is predicated on the possible medicinal advantages of the active constituents of phytosomes. For example, phytosomes' capacity to scavenge free radicals and act as antioxidants may have an antihepatotoxic effect in vitro. The efficacy of generated phytosomal formulation against thioacetamide-induced hepatotoxicity in animals was investigated in order to evaluate in-vivo anti-hepatotoxic activity. In-vivo investigations are conducted on Wistar rats, rodents, and beagle dogs to evaluate the pharmacokinetic characteristics of pure extract and phospholipid complex. [28]

SR.NO	PLANT PART	BOTANICAL NAME	CHEMICAL CONSTITUENT	PRODUCT	USE	REFERENCES
1.	Sweet wood	Glycyrrhizabra	Glycyrrhetic acid	Glycyrrhetic acid Phytosome™	Dermatitis, Antiinflammatory	[29]
2.	Haldi	Curcuma longa	Curcuminoids	CurcuminPhytosome™	Anti-inflammatory, anticancer, osteoarthritis	[30-31]
3.	Tea	Camellia sinensis	Epigallocatechin	Green tea Phytosome™	Anticancer	[32]
4.	Chirata	Swertiaalternifolia	Xanthones 26	SwertiaPhytosome™	Decreasing blood sugar level	[33-34]
5.	Soya bean	Glycinemax	Genistein and daidzein	SoyseselectPhytosome™	Cardioprotective, increase immunity	[29]
6.	European Chestnut	Aesculushippocastanm	Saponins	Escin β sitosterol Phytosome™	Vasoactive properties And Anti-oedema	[29]
7.	Pine	Pinus maritime	Procyanidins	PycnogenolPhytosome™	Antiwrinkle	[35]

Table : 3 Marketed phytosome products

Advances in Phytosome

- Encapsulated curcumin was used to treat adult Albino Wistar rats for hemolytic anemia caused by phenylhydrazine (PHZ). Hematological characteristics and cytogenic activity were evaluated. According to the latest research, load curcumin on the phytosomes with a high enough polydisperssinindex preserves the stability of the phytosomes and demonstrates a potent ability to mitigate the anemic effects of phenyl hydrazine. This may present a chance to create a novel treatment strategy for different types of pathological and physiological anemia.[36]
- It has been discovered that spherical phosphidonylcholine (PC) and PPE (pomegranate peel extract) gamma-oryzanol (GO)nano-phytosomes (NPs) are a feasible delivery system for protecting PPE's bioactivity, which includes cytotoxicity and antioxidant qualities against cancer cell lines.[37]
- Adding chitosan to the formulation and coating of curcumin (CR) to increase its effectiveness. When compared to artemisinin, CR showed almost identical and low binding energies in silicon molecular docking tests, suggesting good stability at the target location. The

effectiveness of CR in treating and decreasing Plasmodium falciparum parasites for drug-resistant malaria has been proven.[38]

- For dermatitis that resembles psoriasis, the *Heydotiscorymbosa* (L.) Lam. extracted nanogel form presents a possible path for enhanced penetration and extended skin deposition. Skin penetration and dermatokinetics were assessed both in vivo and ex vivo after tailored nanophytosomes (NPs) were added to a pluronic gel base to form nanogel. A more effective and skin-retaining phytoconstituent-based nanogel may be used to treat dermatitis similar to psoriasis.[39]
- These days, the Covid-19 virus is having a negative impact on people's life and raising the death rate. Because of this, scientists are concentrating on creating novel antiviral medications to tackle the COVID-19 pandemic caused by the virus SARS-Cov-2. Despite its limited oral bioavailability, quercetin is a polyphenol with antiviral properties. Quercetinphytosome, also known as Quercetinphytosome®, was tested on humans to see if bioavailability was improved. Quercetin inhibits the 3CLpro, PLpro, and S proteins, which are mostly in charge of viral propagation, according to research using molecular docking.[40]
- A further research investigation found that the *Centellaasiatica* L phytosome improved cognitive function by upregulatingBdnf, or transcription inside the rat prefrontal brain cortex. Bdnf is a key regulator of brain plasticity. They are aware of the ways in which cognitive performance therapy has been enhanced by the Novel Object Recognition (NOR) exam. Using *Centellaasiatica* L phytosomes was found in a different study, to improve cognitive function by upregulatingBdnf expression in the rat prefrontal cortex.[41]

II. CONCLUSION

Whenever it comes to delivering bioactive substances produced from plants, phytosomes offer a potential platform that can help overcome the problems caused by low solubility and bioavailability. The characterization, characteristics, and formulation of phytosomes are still being explored. This study has enormous potential to provide new phytopharmaceuticals with improved therapeutic advantages and clinical usefulness.a novel phytosome formulation that

facilitates the use of herbal remedies and eliminates obstacles to the development of a dosage form for increased combination bioavailability. Its successful novel phytosome formulation process and increased commercialization scale are advantageous to the pharmaceutical industry. The majority of phytosomes' constituent parts are nontoxic and stable.Phytosomes will be developed in the future to deliver drugs with minimal side effects and maximal effectiveness.Whether new pharmaceuticals are developed or existing ones are used more efficiently, every ailment may be treated more effectively and safely. The phyto-phospholipid combination method has become an essential means for enhancing the effectiveness of natural remedies and solving the problem of adequate permeability of lipid membranes. This working together investigation has cleared the way for the creation of better nanosized herbal medicines, which might one day become phytopharmaceuticals with the potential to enhance public health. It mixes cutting-edge drug delivery technology with traditional herbal remedies.

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