ISSN: 0976-7126
Maliwal *et al.,* 16(5):1-5, 2025

International Journal of Pharmacy & Life Sciences
Open Access to Researcher

Review on Phytosomes: A Novel Drug Delivery System

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Article info

Received: 16/02/2025

Revised: 25/03/2025

Accepted: 25/03/2025

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Abstract

Phytosomes are an advanced form of herbal drug delivery system designed to enhance the bioavailability of plant-derived active compounds. These vesicular structures improve the solubility, stability, and absorption of phytoconstituents, making them an innovative approach in herbal medicine and pharmaceuticals. This review explores the structure, preparation methods, advantages, and applications of phytosomes in drug delivery.

Keywords: Novel Drug Delivery, Phytosomes, Advancements

Introduction

Phytoconstituents such as flavonoids, polyphenols, and terpenoids possess significant therapeutic benefits but suffer from poor bioavailability due to low lipid solubility and rapid metabolism. [1]

Phytosomes are a type of advanced herbal formulation that enhances the bioavailability and effectiveness of plant-based compounds. The term "phytosome" is derived from two words: "phyto," meaning plant, and "some," referring to a lipid-based structure. Essentially, a phytosome is a complex made by combining a plant extract with phospholipids (like phosphatidylcholine, a key component of cell membranes).

Phytosomes, lipid-compatible molecular complexes, address this limitation by forming amphiphilic vesicular systems that enhance the absorption and therapeutic efficacy of herbal extracts. [2]

Structure and Composition

Phytosomes are composed of:

- **Phospholipids** (e.g., phosphatidylcholine) that interact with plant constituents to form vesicles.
- **Phytoconstituents** (e.g., curcumin, quercetin, silymarin) with medicinal properties.
- **Solvents and stabilizers** to maintain vesicle integrity.

These complexes improve membrane permeability, facilitating better absorption in biological systems. [3]

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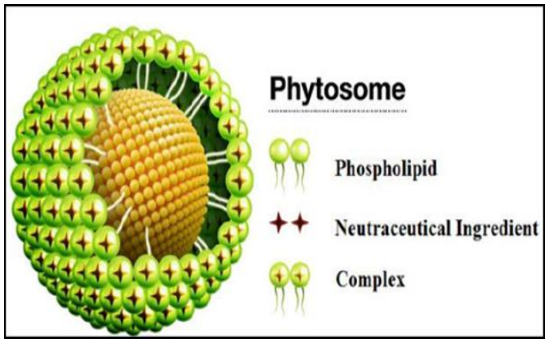

Fig. 1: Structure of Phytosomes

Mechanism

Encapsulation in Phospholipids
Phytosomes are created by binding plant extracts (like those from herbs) to phospholipids, typically in the form of liposomes. This helps improve the solubility and stability of the plant compound.
Improved Bioavailability
Many herbal compounds, such as polyphenols and flavonoids, are poorly absorbed by the body when taken orally due to their large molecular size or low solubility. By incorporating these compounds into phytosomes, the liposomal structure enhances absorption through cell membranes, allowing the active ingredients to reach their target sites in the body more effectively.
Better Efficacy
Because phytosomes improve the bioavailability of plant compounds, they often lead to better therapeutic effects compared to traditional herbal supplements.
Examples of Use
Phytosomes are commonly used in supplements to deliver herbs like Ginkgo biloba, Turmeric (curcumin), Milk Thistle (silymarin), and others. These herbs have active ingredients that benefit from the phytosome technology for better absorption and enhanced activity in the body.
phytosomes represent a way to optimize the use of natural plant extracts, making them more effective for therapeutic purposes by overcoming limitations like poor absorption and stability. [4]

Preparation Methods
Phytosomes are synthesized using various techniques, including: [5]

Solvent evaporation method
Dissolving phospholipids and phytoconstituents in a suitable solvent, followed by evaporation to form vesicles.
Anti-solvent precipitation
Rapid precipitation by adding a non-solvent.
Thin-film hydration
Formation of a lipid film, followed by hydration to create vesicles.
Sonication method – Ultrasonic energy used to form uniform vesicles.
Advantages of Phytosomes

- **Enhanced bioavailability** – Improved solubility and absorption.
- **Better stability** – Protection against degradation.
- **Increased therapeutic efficacy** – More effective drug delivery.
- **Reduced dosage frequency** – Improved patient compliance.

Applications in Drug Delivery
Phytosomes have found applications in treating various conditions, including:
Liver disorders – Silymarin phytosomes for hepatoprotection.
Cardiovascular diseases – Quercetin phytosomes for antioxidant effects.
Neurodegenerative disorders – Curcumin phytosomes for cognitive enhancement.
Skin care – Herbal phytosomes in cosmetics for improved skin absorption.

Phytosomes have a wide range of applications, particularly in the field of healthcare and nutrition. Due to their ability to improve the bioavailability and absorption of plant-based active ingredients, phytosomes are used in various formulations for therapeutic purposes. Here are some of the primary applications: [6]
Herbal Supplements and Nutraceuticals
Phytosomes are commonly used in dietary supplements to improve the delivery of plant-based compounds. Some examples include:

- **Curcumin (Turmeric)**: The active ingredient in turmeric, curcumin, has anti-inflammatory and antioxidant properties. Phytosome formulations of curcumin enhance its absorption, making it more effective for conditions like arthritis, digestive issues, and oxidative stress.

- **Silymarin (Milk Thistle)**: Silymarin, the active compound in milk thistle, is known for its liver-protective properties. Phytosomes help improve the absorption of silymarin, making it more effective in supporting liver health and detoxification.
- **Ginkgo Biloba**: Phytosome formulations of Ginkgo biloba, known for their cognitive benefits, improve the bioavailability of its active compounds, helping with memory, circulation, and overall brain health.

Cosmetic and Skincare Products

Phytosomes are increasingly being incorporated into cosmetic formulations, particularly for their antioxidant, anti-aging, and skin-healing properties. For example:

- **Anti-aging creams**: Plant extracts such as grape seed extract, green tea polyphenols, and vitamin E are often formulated into phytosomes for better skin penetration and effectiveness in reducing wrinkles and skin damage.
- **Moisturizers and serums**: Phytosomes can improve the hydration and rejuvenation of skin by allowing active plant ingredients like aloe vera, shea butter, or rosehip oil to penetrate deeper into the skin layers, promoting healthier skin.

Pharmaceuticals

Phytosomes are being researched and developed as part of pharmaceutical formulations to treat or manage various medical conditions. Some applications include:

- **Anti-inflammatory treatments**: Phytosomes containing compounds like curcumin or boswellic acid (from Boswellia) are used to treat inflammatory conditions, such as arthritis, where increased absorption of active ingredients improves therapeutic outcomes.
- **Liver and digestive health**: Phytosomes of silymarin (milk thistle) and artichoke extract are used to treat liver disorders, promote detoxification, and support overall gastrointestinal health.

Weight Management and Metabolism Support

Certain phytosome formulations are used in weight loss or metabolic health products. For example:

- **Green tea extract**: Known for its metabolism-boosting and fat-burning properties, green tea polyphenols can be formulated into phytosomes to improve absorption and efficacy in weight management supplements.
- **Garcinia Cambogia**: This plant extract, which is often used in fat-burning supplements, can be made into phytosomes for better bioavailability, making it more effective in controlling appetite and promoting fat loss.

Cardiovascular Health

Phytosomes are also used in formulations aimed at improving heart health. Examples include:

- **Coenzyme Q10 (CoQ10)**: While CoQ10 is naturally produced in the body and is important for heart health, its bioavailability can be enhanced by using phytosome technology. This makes it more effective in improving heart function, reducing oxidative stress, and supporting overall cardiovascular health.
- **Omega-3 fatty acids**: Phytosome formulations containing omega-3s (e.g., from fish oil or flaxseed) can enhance absorption and support heart health by lowering cholesterol, reducing inflammation, and improving circulation.

Diabetes and Blood Sugar Regulation

Phytosomes can be used to enhance the effects of herbs and plant extracts that help manage blood sugar levels and insulin sensitivity. For example:

- **Berberine**: Known for its potential to regulate blood sugar, when formulated as a phytosome, it can have a higher bioavailability, making it more effective in managing type 2 diabetes or insulin resistance.

Anti-cancer Properties

Some phytosomes are being studied for their potential anti-cancer effects. For instance:

- **Green tea catechins**: Epigallocatechin gallate (EGCG), a powerful antioxidant found in green tea, can be delivered more effectively through phytosomes, helping

in cancer prevention by inhibiting tumor growth and reducing oxidative damage.

Neurological Health

Phytosomes are also used to deliver compounds that support brain health. For example:

- **Phosphatidylserine**: A phospholipid used to support cognitive function and memory, when combined with phytosome technology, it enhances brain penetration and is used to treat age-related cognitive decline and neurodegenerative diseases.

Immune System Support

Phytosome formulations can enhance the bioavailability of plant extracts used to boost immunity. For example:

- **Echinacea**: Known for its immune-boosting properties, echinacea extract can be formulated into phytosomes to improve its absorption and effectiveness in preventing colds and infections.

Anti-stress and Mood Enhancement

Phytosomes are also found in products that help manage stress and improve mood. For example:

- **Ashwagandha**: This adaptogenic herb is often used in phytosome formulations to help reduce stress and anxiety while improving overall well-being by promoting a balanced hormonal response.

Phytosomes represent a significant advancement in the delivery of plant-based active ingredients, offering improved bioavailability and therapeutic effects. Their applications are diverse, ranging from dietary supplements to skincare, pharmaceuticals, and beyond. By improving the absorption and stability of plant compounds, phytosomes help maximize the health benefits of herbs and natural substances.

Recent Advancements in Phytosomes: Challenges and Future Prospects

Despite their advantages, phytosomes face challenges such as stability issues and scalability in manufacturing. Future research should focus on optimizing formulations, exploring new phytoconstituents, and conducting clinical trials to validate their efficacy. [7]

Phytosomes are a novel drug delivery system that enhances the bioavailability of plant-based compounds by forming lipid-compatible molecular complexes. In recent years, there have been significant advancements in phytosome technology, particularly in the areas of formulation, therapeutic applications, and targeted delivery. Here are some notable recent advancements:

Enhanced Formulation Techniques

- **Nanophytosomes**: The development of nanophytosomes has improved solubility, absorption, and controlled drug release.
- **Spray Drying and Freeze Drying Methods**: These advanced preparation techniques have improved the stability and shelf-life of phytosome formulations.
- **Polymeric and Hybrid Phytosomes**: The combination of polymers or nanoparticles with phytosomes has enhanced drug loading and controlled release.

Improved Bioavailability and Stability

- **Self-Assembling Phytosomes**: These enable better encapsulation of hydrophobic phytochemicals, improving their solubility and bioavailability.
- **PEGylated Phytosomes**: Coating phytosomes with polyethylene glycol (PEG) increases their stability in biological fluids and prolongs circulation time.

Targeted and Sustained Release Systems

- **Smart Phytosomes**: pH-sensitive and enzyme-responsive phytosomes have been developed for targeted drug delivery, especially in cancer therapy.
- **Mucoadhesive Phytosomes**: These formulations improve adhesion to mucosal surfaces, enhancing absorption in oral and nasal delivery.

New Therapeutic Applications

- **Neuroprotective Phytosomes**: Recent studies show their potential in managing neurodegenerative diseases like Alzheimer's and Parkinson's.
- **Anti-Cancer Phytosomes**: Enhanced delivery of polyphenols such as curcumin and quercetin improves anti-tumor effects.

- **Anti-Inflammatory and Antioxidant Uses**: Improved formulations of resveratrol and green tea catechins have shown enhanced efficacy in reducing oxidative stress.

Commercial Developments

Several phytosome-based products are now available, including **Meriva® (curcumin phytosome)** and **Siliphos® (silymarin phytosome)**, with proven clinical benefits.

Conclusion

Phytosomes represent a promising drug delivery system that overcomes the limitations of traditional herbal formulations. Their ability to enhance bioavailability and therapeutic potential makes them a valuable innovation in herbal and pharmaceutical sciences.

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Cite this article as:
Maliwal K., Chasta P. and Ali Z. Md. (2025). Review on Phytosomes: A Novel Drug Delivery System. *Int. J. of Pharm. & Life Sci.*, 16(5): 1-5.

Source of Support: Nil
Conflict of Interest: Not declared
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