

A Comprehensive Review of Phytosomes: Formulation, Characterization, and Therapeutic Applications

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Abstract

The capacity of phytosomes to enhance the absorption and bioavailability of bioactive components from plant extracts has made them a notable breakthrough in the fields of dietary supplements and herbal medicine. Using this innovative method, plant extracts are molecularly complexed with phospholipids to produce lipid complexes that resemble cell membrane structures. Because of their structural similarity, these bioactive chemicals are better soluble and absorbed, which makes them easier for the body to use. Pharmaceuticals, nutraceuticals, cosmetics, and functional foods are just a few of the businesses that use phytosomes. Numerous health advantages have resulted from their adaptable use, including protection against antioxidants, improved cognitive function, liver health support, and cardiovascular well-being. However, individual reactions could differ, so exercise caution and seek advice from medical professionals, particularly when used in conjunction with prescription drugs or for particular medical conditions. Phytosomes offer a more effective and efficient way to extract the medicinal qualities of plant extracts, which is a promising development in herbal medicine and nutrition. Their capacity to augment the transportation of bioactive substances presents novel prospects for enhanced health and overall well-being, rendering them a remarkable augmentation to the domain of alternative medicines and dietary supplements.

Key words: Antioxidant, bioactive chemicals, liver health support, molecularly complexed

INTRODUCTION

In the realm of herbal medicine and natural supplements, phytosomes represent a revolutionary development. About enhancing the absorption and bioavailability of bioactive chemicals produced from plant extracts, these customized formulations offer a novel approach.^[1] Phytosomes have transformed the way our systems may utilize the medicinal potential of herbal treatments by mixing plant extracts with phospholipids via a process called molecular complexation. Phytosomes' main goal is to solve the problems of poor absorption and solubility, which frequently restrict the efficacy of herbal supplements and botanical treatments. Lipid complexes that closely mirror the lipids found in cell membranes are created when phospholipids and plant extracts are combined. Since their structures are similar, it is easier for them to integrate into cell membranes, increasing the bioactive chemicals' bioavailable and easily absorbed by the body.^[2] Phytosomes are a flexible and efficient way to incorporate a variety of herbal and botanical ingredients into

formulations for health and wellness. Applications for them can be found in the pharmaceutical, nutraceutical, cosmetic, and functional food industries in addition to traditional herbal therapy.

Many health benefits, including liver support, cognitive enhancement, cardiovascular health, and antioxidant protection, to mention a few, have been made possible by the improved absorption and tailored distribution of phytosome technology.^[3] Although phytosome-based products are usually thought to be safe and well-tolerated, it is important to take individual variances into account and seek advice from health-care specialists when incorporating them into your routine for overall wellness. To sum up, phytosomes are a fascinating

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Received: 28-11-2023

Revised: 17-02-2024

Accepted: 13-03-2024

development in the fields of herbal medicine and nutritional supplements, offering a method for utilizing the therapeutic qualities of plants found in nature that is more effective and efficient.^[4] Within the realm of natural medicines and supplements, their potential to improve the distribution of bioactive components is promising for better health and well-being, which makes them an interesting and worthwhile choice.

WHAT ARE PHYTOSOMES

Specialized, patented herbal formulations known as phytosomes improve the absorption and bioavailability of bioactive chemicals produced by plants. Their purpose is to enhance the dispersal of phytoconstituents, which include polyphenols and other advantageous substances present in diverse plant extracts.^[5] The solubility of the plant-derived chemicals in lipids and water is increased by this binding mechanism, facilitating their easier absorption by the body.

These are important concepts regarding phytosomes to grasp

1. **Enhancement of Bioavailability:** To address the restricted bioavailability of certain chemicals originating from plants, phytosomes have been developed. The body may find it difficult to absorb a large number of bioactive compounds derived from plants due to their limited water solubility.^[6] Because phytosomes increase solubility, they show how well these substances work and how bioavailable they are.
2. **Phytosomes can be utilized in conjunction with a range of herbal extracts, including those derived from grape seed, milk thistle, *Ginkgo biloba*, green tea, and more.^[7] Based on the desired health advantages, a plant extract is selected.**
3. **Applications:** Nutritional supplements, herbal medicines, and topical cosmetics all include phytosomes. They assist the liver and improve cognitive function, the heart, the skin, and many other areas of health.
4. **Health of the Liver:** Due to its hepatoprotective (or liver-protective) qualities, phytosomes containing silymarin from milk thistle are frequently utilized to promote liver health.
5. **Memory and cognitive function are supported by certain phytosomes, such as those containing *G. biloba* extract.**
6. **Skincare:** The usage of phytosomes in skincare products to improve the absorption of plant extracts, which offer anti-aging, shielding, and moisturizing properties to the skin.
7. **Safety:** When used as prescribed, phytosomes are usually regarded as safe. It is imperative to select items from manufacturers with a good reputation and adhere to dosage guidelines.
8. **Research:** Several phytosome formulations have been the subject of clinical investigations, which have

demonstrated their safety and effectiveness in particular health applications.

9. **Quality Control:** Seek out brands that follow appropriate production practices and independent testing to guarantee the efficacy and quality of phytosome products. The uniformity and safety of products are enhanced by quality control procedures.

A novel strategy for maximizing the medicinal potential of bioactive substances produced from plants is the use of phytosomes. Because of their capacity to increase the bioavailability of these substances, they are beneficial in a variety of health concerns apps for wellness.^[8] Seeking advice from a health-care provider is recommended when thinking about phytosome products, particularly if you are using medication or have particular health issues.

MANAGEMENT OF PHYTOSOMES

1. **Phospholipids and Plant Extracts Complicated:** Molecular complexation is the chemical process by which phytosomes are produced. Phospholipids, usually phosphatidylcholine, are mixed with plant extracts that contain bioactive chemicals.^[9] Natural materials called phospholipids are present in cell membranes and exhibit both hydrophilic (attractive to water) and hydrophobic (attractive to lipids) characteristics.
2. **Lipid Complex Formation:** Lipid complexes are created when plant extracts attach themselves to phospholipids. These complexes are compatible with the lipid bilayers prevalent in the body because of their structural similarity to the lipids found in cell membranes.
3. **Improved Dissolution:** The normally hydrophobic (lipid-soluble) bioactive chemicals from the plant extracts become more soluble due to the formation of lipid complexes in phytosomes. This is especially crucial because a lot of herbal components have low solubility in water, which may restrict how much they absorb.
4. **Enhanced Absorption:** The phospholipids in the complexes can fuse with the gastrointestinal tract's cell membranes on consumption of phytosomes. This facilitates the easier passage of the bioactive substances across the lipid layers of cell membranes.^[10] Consequently, as opposed to conventional herbal extracts, the absorption of these components is markedly improved.
5. **Personalized Delivery:** Because they absorb better than other materials, phytosomes can more efficiently transport bioactive substances to specific tissues. Because the chemicals are more easily able to work within the body as a result of this focused delivery, the therapeutic effects of the herbal extracts may be enhanced.
6. **Flexibility:** Herbal extracts from a variety of natural sources, such as fruits, herbs, and other sources, can be utilized with phytosomes.^[11] As such, phytosomes are versatile enough to be used in a wide range of health and wellness formulations.

By forming lipid complexes, phytosomes enhance the solubility and absorption of bioactive substances found in plant extracts. Phytosomes increase the bioavailability and therapeutic effects of herbal treatments by aiding in the delivery of these chemicals to target tissues.^[12] The pharmaceutical, nutraceutical, and cosmetic sectors have come to favor this novel strategy.

Improved bioavailability phytosomes

One of the phytosomes' main advantages is their increased bioavailability. By facilitating their easier absorption and utilization by the body, phytosomes improve the bioavailability of active chemicals derived from plant extracts. Phytosomes have a unique structure that allows for the binding of plant extracts to phospholipids, including phosphatidylcholine, to form a molecular complex, which results in enhanced bioavailability. Better therapeutic effects result from this complexation, which helps overcome the drawbacks of some herbal components' low solubility and promotes their absorption.^[13] Phytosomes are often more effective at delivering bioactive components to target tissues than standard herbal extracts, which leads to improved health benefits and efficacy.

1. **Greater Solubility:** Hydrophobic (lipid-soluble) bioactive substances are made more soluble by phytosomes. Potassium-insoluble chemicals are present in a lot of natural plant extracts, which can hinder the body's ability to absorb them through the digestive tract. Phytosomes enhance the solubility of these substances in water by binding them to phospholipids, so facilitating their dissolution in gastrointestinal fluids.^[14]
2. **GI Uptake:** Plant extracts bound to phospholipids form lipid complexes that are better able to move across the lipid-rich environment of the gastrointestinal system when phytosome-containing goods are consumed. In the small intestine, where absorption mostly takes place, this facilitates the bioactive chemicals' effective transit.^[15]
3. **Enhanced Cellular Uptake:** It is easy for phytosomes to merge with tiny intestinal cell membranes due to their phospholipid components. What phospholipids have in common with the lipids present in cell membranes facilitates the more efficient passage of bioactive substances through these membranes. Increased bloodstream absorption is facilitated by this.^[16]
4. **Certain substances that are soluble in fat may be absorbed through the lymphatic system, avoiding the liver on their initial passage through the circulation. Certain bioactive chemicals have the potential to be more bioavailable when facilitated by phytosomes.**
5. **Bypassing First-Pass Metabolism:** Phytosomes may aid bioactive substances to circumvent the liver's first-pass metabolism to some degree by improving the absorption of these compounds in the small intestine and maybe by promoting lymphatic absorption. The systemic circulation may include larger concentrations of the

chemicals as a result.^[17]

6. **Targeted Delivery:** Phytosomes have a higher capacity to transport bioactive substances to particular organs and tissues. With this focused distribution, the compounds are guaranteed to be able to have the physiological effects that they were designed to.

When bioactive substances from plant extracts are administered as phytosomes, the overall effect of these procedures is a notable increase in the absorption of those chemicals.^[18] For herbal treatments and supplements that use phytosome technology, this improved absorption adds to their higher bioavailability and efficacy.

APPLICATION OF PHYTOSOMES

Phytosomes are widely used in many different industries because they can improve the bioavailability and absorption of bioactive substances found in plant extracts.^[19] Here are a few typical uses for phytosomes:

1. **Dietary supplements and nutraceuticals:** To enhance the distribution of herbal and botanical extracts, phytosomes are often employed in these products. Numerous health supplements, including those that assist the liver, improve cognitive function, support cardiovascular health, and more, contain them.
2. **Pharmaceuticals:** Herbal extracts and other bioactive substances are employed in pharmaceutical products, which is why phytosome technology is applied in this sector. Herbal medications for some medical ailments are one example of this.
3. **Cosmetics and Skincare:** To improve the delivery of plant-based compounds that have positive effects on the skin, phytosomes are added to cosmetic goods. Green tea, *G. biloba*, and other botanical extracts are examples of substances included in phytosome-based skincare products.
4. **Functional meals:** To improve the bioavailability of bioactive ingredients, several functional meals and beverages contain phytosomes. Elements that are good for you, such polyphenols, antioxidants, or other substances.
5. **Traditional herbal medicines are enhanced in effectiveness by the application of phytosome technology, which enhances the transport and absorption of active chemicals.**
6. **Sports and Performance Supplements:** In the sports and performance sector, phytosome-based supplements are utilized to improve the absorption of nutrients and herbal compounds that are beneficial to athletes and fitness lovers.
7. **Weight Control Products:** To enhance the absorption of components that promote metabolism and fat reduction, phytosomes are used in weight control pills.
8. **Product Anti-Aging:** Resveratrol and coenzyme Q10 are two examples of substances with potential anti-aging benefits; some product anti-aging solutions use phytosomes to boost the bioavailability of phytosome

technology to improve the delivery of chemicals that assist cognition, such as those found in herbs. *Bacopa Monnier* or *G. biloba*?

9. Digestive Health: The utilization of phytosomes in supplements for digestive health might enhance the absorption of herbal ingredients that assist the gastrointestinal tract.
10. Cardiovascular Health: Phytosomes are used in certain supplements for cardiovascular health to boost the bioavailability of heart-healthy substances like flavonoids or polyphenols from plants like red yeast rice or hawthorn.
11. Anti-Inflammatory Products: Products containing herbal extracts with anti-inflammatory properties are enhanced in their ability to reduce inflammation and its accompanying symptoms by the application of phytosome technology.

A broad range of products intended for health and wellness, as well as cosmetic and pharmaceutical uses, can benefit from the unique and adaptable approach that phytosomes provide to herbal medicine and the administration of bioactive chemicals.^[20] Depending on the intended use and desired health or cosmetic benefits, several phytosome-based products may be chosen.

HEALTH BENEFITS OF PHYTOSOMES

The capacity of phytosomes to improve the absorption and bioavailability of bioactive chemicals from plant extracts is the main reason for their many health advantages. The particular plant extract utilized and its characteristics determine the health advantages of phytosomes.^[15] The following are some typical health advantages of phytosome technology:

1. Liver Support: Milk thistle phytosomes and other phytosome formulations are well-known for their capacity to promote liver health. Milk thistle's main ingredient, silymarin, can be more efficiently transported to the liver, supporting healthy liver function and shielding it from contaminants.
2. Cognitive Function: Phytosomes can improve memory and cognitive function, particularly those made from *Bacopa Monnier* or *G. biloba*. Better absorption of these herbs' bioactive components may promote cognitive function and brain health.
3. Heart Health: Products containing hawthorn or red yeast rice extracts, for example, are examples of phytosomes that can enhance heart health. They might improve general heart health and lower cholesterol.
4. Profound antioxidants from sources such as green tea, grape seed, or curcumin can be delivered using phytosomes.
5. Anti-Inflammatory Effects: Because of their better absorption, phytosomes-containing anti-inflammatory herbs like curcumin or *Boswellia serrata* may have stronger anti-inflammatory effects. Conditions

associated with inflammation can be treated with them.

6. Joint Health: Herbal extracts such as curcumin and *B. serrata* are found in supplements for joint health that use phytosome technology. These goods might aid in reducing joint discomfort and enhancing joint movement.
7. Weight Control: To improve the absorption of components that support metabolism and fat reduction, several weight control pills contain phytosomes. Green tea phytosomes, for instance, might aid in attempts to control weight.
8. Digestive Health: By raising the bioavailability of the digestive-supporting herbs' active ingredients, such as artichoke or ginger, phytosomes may assist in enhancing gastrointestinal health. Combinations.
9. Skin Health: By stimulating the delivery of advantageous plant extracts, phytosome-based cosmetic products can enhance the health of the skin. The antioxidant and anti-aging properties of green tea phytosomes, for instance, may be present in skincare products.
10. Benefits Against Aging: Phytosomes augment the bioavailability of substances like coenzyme Q10 and resveratrol that may have anti-aging effects.
11. Immune Support: A few supplements that improve the immune system include phytosomes made of herbs that strengthen the immune system, such as echinacea. These substances can have greater immune-stimulating effects if they are better absorbed.
12. Stress Reduction: By increasing the bioavailability of stress-relieving substances, certain phytosomes made from adaptogenic herbs like ashwagandha may promote general well-being and stress relief.

It is crucial to remember that the precise health advantages of phytosomes vary depending on the plant extract utilized, product quality, and personal circumstances. To make sure phytosome-based supplements or products are suitable for your needs and to figure out the proper dosage, speak with a healthcare provider before using them for specific health goals [Table 1].

SAFETY AND COMPATIBILITY OF PHYTOSOMES

Most people tolerate phytosomes well and they are regarded as safe in general. As with any dietary supplement or herbal product, there may be quality variances; therefore, it is critical to be aware of the following safety and compatibility factors:^[21]

1. Quality and Source: The phospholipids and plant extracts utilized in phytosome-based products, as well as their quality and source, can affect their efficacy and safety. Selecting goods from reliable producers and companies that follow quality control guidelines is crucial [Figure 1].
2. Individual Sensitivity: Although most people respond positively to supplements containing phytosomes, reactions can differ from person to person. Since some people might be more sensitive to specific phospholipids

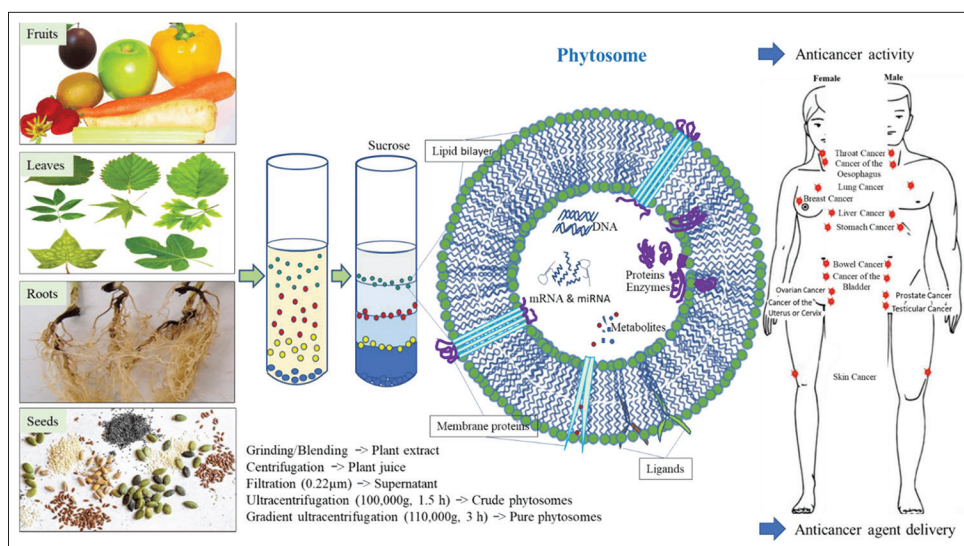


Figure 1: Mechanism of phytosomes^[26]

Table 1: Phytosome products

Product name	Plant extract	Health benefits	Dosage	Potential interaction
Phytosome A	Milk thistle	Liver support	1 Capsule daily	Consult with a healthcare provider if taking medication that affects liver function
Phytosome B	<i>Ginkgo biloba</i>	Cognitive function	2 Capsules daily	Consult with a health-care provide, especially if taking blood-thinning medication
Phytosome C	Hawthorn extract	Cardiovascular health	1 Tablet daily	Consult with a healthcare provider if taking medications for a heart condition
Phytosome D	Green tea extract	Antioxidant protection	1 Capsule twice daily	Monitor caffeine intake from other sources, as green tea contains caffeine
Phytosome E	Curcumin	Anti-inflammatory	1 Capsule daily	Consult with a healthcare provider, especially if taking anticoagulant medications
Phytosome F	<i>Boswellia serrata</i>	Joint health	2 tablets daily	Consult with a health-care provider, particularly if experiencing digestive issues
Phytosome G	Artichoke extract	Digestive health	1 Capsule daily	Consult with a healthcare provider if you have gallbladder issues
Phytosome H	Echinacea	Immune support	1 Capsule daily	Consult with a health-care provider, especially if you have an autoimmune disorder

or plant extracts, it's best to start with a lesser dosage and keep an eye out for any negative responses.

- Allergies: To prevent allergens, people with a history of allergies to particular plant extracts or ingredients included in phytosome formulations (such as phospholipids derived from soy) should use caution and closely read product labels.
- Interactions: Supplements based on phytosomes may have interactions with specific drugs or other supplements. To illustrate, they can because of their anticoagulant qualities, could intensify the effects of blood-thinning drugs. Before using phytosome-based products in your regimen, if you are taking medication, speak with a healthcare provider.
- Pregnancy and lactation: People who are pregnant or

nursing should use phytosome-based supplements with caution since there may not be enough research on their safety during these times. Before utilizing such products, it is essential to speak with a health-care professional.

- Underlying Medical diseases: People who have certain medical diseases, such as clotting disorders or liver illness, should speak with a doctor before taking phytosome supplements because they may need to take special considerations.
- Dosage and Duration: You must adhere to the manufacturer's stated dosage guidelines or the advice of a health-care professional. Excessive intake or extended use of high-dose supplements could have negative outcomes.
- Control of Quality: Seek out goods that have undergone

quality, purity, and contamination-free testing. This can support ensuring that the phytosome-based supplement of your choice is safe.

9. Consultation with a Health-care practitioner: It is essential to get the advice of a healthcare practitioner before beginning any new supplement regimen, particularly for specific health issues. The provider may offer tailored recommendations and track your progress.
10. Although phytosome-based supplements seldom cause adverse effects, some people may have mild digestive discomfort, such as upset stomach or diarrhoea. Stop using the product and get medical advice if you encounter any negative side effects.

Utilizing phytosomes correctly can improve the absorption of bioactive substances from plant extracts securely and efficiently. To be sure they are appropriate for your unique health profile, you should speak with a health-care provider and use caution when using them, particularly if you have any specific health issues or are on other medications.

RESEARCH AND CLINICAL STUDIES OF PHYTOSOMES

Investigations on the effectiveness and advantages of phytosomes in a range of health-related domains have been carried out through research and clinical studies. Here are some noteworthy areas where phytosomes have been examined, while the study on the subject is still ongoing: ^[22]

1. Liver function: Research has looked into the possibility of milk thistle phytosomes, sometimes referred to as silybin phytosomes, to support liver function. Studies suggest that protecting the liver from toxins and improving its general health may have benefits.
2. Cognitive Function: A lot of research has been done on the effects of phytosomes made from *G. biloba* and *Bacopa monnieri*. Clinical research on their effects on memory, attention, and cognitive function has shown some encouraging findings for those managing cognitive decline.
3. Cardiovascular Health: Studies have looked into the potential advantages of red yeast rice extract or hawthorn in phytosome formulations for the cardiovascular system. Research has been done on their capacity to enhance heart health, lower cholesterol, and increase blood flow.
4. Antioxidant Protection: Research has evaluated the antioxidant capabilities of phytosomes, especially those derived from green tea or extracted grape seeds. Antioxidants have the power to shield cells from oxidative damage and enhance general health.
5. Studies have looked into the possible use of phytosomes that contain inflammatory conditions such as arthritis and inflammatory bowel problems that can be treated with two anti-inflammatory herbs: curcumin and *B. serrata*.
6. Joint Health: Studies have been conducted on the effects of phytosome-based supplements, especially those

containing *B. serrata* and curcumin. Various studies have examined the efficacy of various therapies in lowering joint discomfort and enhancing range of motion.

7. Weight control: Studies have looked at adding phytosomes to supplements to boost their effectiveness in helping people lose weight. Because of studies on the possible benefits of green tea phytosomes for fat metabolism and weight loss, for instance, have been carried out.
8. Digestion: A number of clinical studies have examined the advantages of phytosome formulations that contain nutrients to support digestion. Like radishes or ginger plants. This investigation seeks to assess their efficacy in enhancing gastrointestinal well-being.
9. Skin Health: Research has evaluated the effects of cosmetics containing phytosomes on skin health. Phytosomes used topically may improve the skin by providing antioxidant and anti-aging properties.
10. Immune system support: Studies on herbs that contain phytosomes, such as echinacea, have evaluated the phytosomes' capacity to assist the immune system.

It is important to remember that the results of these studies can vary, and more research is ongoing to further explore the potential of phytosomes in various health-related applications. Nevertheless, the outcomes of these studies can help guide the development of products based on phytosomes and provide valuable insights into their efficacy and safety. In light of phytosome supplementation, it's important to order to make well-informed judgments based on specific health needs, it is advised to speak with a healthcare provider and study the available scientific literature.

DOSAGE AND FORMULATIONS:

1. Different formulations and dosages of phytosome-based products may work best depending on the specific plant extract and its intended use. Following the manufacturer's instructions and, if needed, consulting a healthcare professional directly are essential. The following should be kept in mind while determining the dosage and makeup of phytosome products:
2. As the manufacturer instructs: Follow the directions for usage and dosage provided on the product label with great care. These instructions are guaranteed to be safe and effective.
3. Look Into That Specific Plant Extract: Different plant extracts with distinct qualities may be included in a variety of phytosome products. Distinct dose recommendations may be made based on the potency of the plant extract and the intended health outcomes.
4. Dosage Forms: Phytosome-containing products are accessible in the form of topical creams, pills, liquid extract, and tablets. Choose a formulation based on your tastes and the desired application. For instance, topical creams are used topically, yet capsules are frequently

taken inside as supplements.

5. **Personal Health Status:** Take into account all aspects of your health, such as age, weight, and any underlying medical disorders. These elements may affect the proper phytosome dose/extras.
6. **See an Expert in Health care:** Seek advice from a health-care expert if you have specific health issues or are unsure of the appropriate dosage. Personalized advice based on your health requirements, possible drug interactions, and medical problems can be given to them.
7. **Duration of Use:** Ascertain whether extended or brief use of the product is planned. While certain phytosome supplements are meant to be used regularly, others might only be advised for brief periods.
8. **Quality and Purity:** To guarantee the formulation's efficacy and purity, select premium phytosome items from reliable producers.
9. **Possible Interactions:** Keep in mind that using supplements or drugs together may have unintended consequences. Talk to your health-care practitioner about using phytosome products to avoid any negative interactions.
10. **Tolerance and Reaction:** Observe how your body reacts to the item. Consult a health-care provider for advice if you encounter any uncomfortable side effects, change the dosage, or stop using the product altogether.
11. **Respect for Clinical Studies:** When available, consult clinical studies and academic publications to gain knowledge about the ideal dosage and results for particular plant extracts and phytosome products.
12. **Combination Formulas:** Supplements containing phytosomes may be found in blends containing many nutrients or herbal extracts. Check to see if the combination supports your health objectives and prevents overdosing on any one ingredient.

It is important to base the dosage and formulation of goods containing phytosomes on the particular product, the plant extract, and the health needs of each individual. It is critical to adhere to suggested rules to optimize benefits and reduce potential hazards. When in doubt, consult a health-care provider for advice that is specific to your requirements.^[23]

TYPES OF PHYTOSOMES

Utilized to improve the absorption and bioavailability of particular bioactive chemicals, phytosomes are made from a variety of plant extracts. Phytosomes can be broadly classified into the following types according to the plant extracts from which they originate:^[24]

1. **Silymarin,** a bioactive substance with liver-protective qualities, is found in milk thistle phytosomes, which are made from the milk thistle plant (*Silybum marianum*). To aid in liver health and detoxification, these phytosomes are employed.
2. ***G. biloba* Phytosomes:** Contained within are flavonoids and terpenoids, and these phytosomes are sourced from

the *G. biloba* tree. Supplements targeted at promoting brain health often contain them because of their ability to improve memory and cognitive function.

3. **Phytosomes made from hawthorn (*Crataegus*) extracts** are known as phytosomes. The heart and circulation are two key areas in which these phytosomes are utilized to enhance cardiovascular health.
4. **Extracts of green tea (*Camellia sinensis*)** are used to make green tea phytosomes. Known for their antioxidant properties, they are abundant in catechins. Antioxidant protection and general health promotion are two common uses for these phytosomes.
5. **The anti-inflammatory and antioxidant curcuminoids** found in curcumin phytosomes are obtained from extracts of turmeric (*Curcuma longa*). Their ability to lower inflammation and promote joint health is why they are utilized.
6. **Phytosomes derived from *B. serrata* trees:** Boswellia acids are found in the extracts used to make *B. serrata* phytosomes. In diseases like osteoarthritis, in particular, these phytosomes are employed to enhance joint health and control inflammation.
7. **Cynara scolymus,** the plant from which artichokes are derived, is the source of artichoke phytosomes. Their ability to promote healthy digestion and enhance liver function is well recognized.
8. **Phytosomes derived from Echinacea extracts** are widely utilized for their immune-boosting properties. It is well known that echinacea can strengthen immunity.
9. **Mango Phytosomes:** Extracts from mangos (*Mangifera indica*) are the source of mango phytosomes. They might provide advantages for skin health, antioxidant defense, and perhaps even weight control.
10. **Phytosomes made from saffron (*Crocus sativus*) extracts** are known as saffron phytosomes. They may be beneficial for ailments including mild-to-moderate depression and can be used to support mood.
11. **Resveratrol Phytosomes:** Made from resveratrol, a substance present in grapes and some other plants, resveratrol phytosomes are generated. They are well-known for having antioxidant and maybe anti-aging qualities.

These are only a few instances of phytosomes that have been made from various plant extracts. The selection of a phytosome kind is contingent upon personal health objectives and preferences, as each variety is linked to distinct health advantages and uses. When taking supplements containing phytosomes, it is critical to adhere to the suggested dosage and seek the advice of medical professionals for specific recommendations.^[25]

PHYTOSOME TECHNOLOGY

One specific method for increasing the bioavailability and absorption of bioactive chemicals from plant extracts

is called phytosome technology. Herbal medicine and dietary supplements have seen a revolution because of this technology.^[27] An outline of phytosome technology's main elements is provided below:

1. **Molecular complexation:** Molecular complexation is the fundamental technique of phytosome technology. It involves combining a phospholipid molecule with a plant extract. The bioactive substances from the plant extract are combined with the phospholipid to form a unique structure through the process of complexation, which is accomplished by chemical bonding.
2. **Phospholipids:** Natural compounds present in cell membranes are called phospholipids. One end of them is hydrophilic, or drawn to water, while the other is hydrophobic, or repulsed by it. This indicates that they are bimodal in nature. A key component of phytosome technology's efficacy is its dual nature. A variety of phospholipids are frequently utilized, such as phosphatidylcholine and phosphatidylserine.
3. **Lipid Complexes:** Plant extract chemicals generate lipid complexes as a result of molecular complexation, where phospholipids encircle and bind the molecules. The phospholipids' hydrophobic tails form a lipid bilayer in these complexes, which bear structural similarities to cell membranes.
4. **Enhanced Solubility:** The solubility of phytosome complexes is enhanced in lipids and water. This is particularly noteworthy because a large number of the bioactive substances found in plant extracts are hydrophobic—that is, poorly soluble in water. Phytosomes enhance the solubility of these substances by attaching them to phospholipids, which increases their water solubility.
5. **Better Absorption:** One of the goals of phytosome complexes is to improve absorption. In the gastrointestinal tract, the phospholipids in the complexes can combine with cell membranes when phytosome-based products are consumed. As a result, bioactive substances are more easily transported across cell membranes and are more readily absorbed.
6. **Targeted Delivery:** Using phytosomes, bioactive substances can be more effectively transported to particular organs and tissues. These chemicals are more readily available to exert their therapeutic effects as a result of their focused administration.

Technology based on phytosomes has various benefits, such as:

1. **Improved Bioavailability:** Phytosomes make bioactive substances far more bioavailable, meaning that a larger proportion of the compounds are taken up and used by the body.
2. **Versatility:** A broad range of plant extracts can be utilized with phytosomes, which allows for their adaptability to a variety of herbal medicines and supplements.
3. **Enhanced efficacy:** Phytosome technology raises the potency of herbal treatments, dietary supplements, and

cosmetics by improving absorption.

4. **Minimized negative Effects:** Because phytosomes enable lower dosages without compromising therapeutic efficiency, there may be a decreased chance of negative effects.

Growing in popularity in the pharmaceutical, nutraceutical, and cosmetic sectors, phytosome technology has created new avenues for enhancing health and well-being through the use of plant-based supplements and herbal therapies.

INTERACTIONS WITH MEDICATION

Similar to a lot of other dietary supplements and herbal products, supplements based on phytosomes may interact with some drugs. The medication's and the supplement's safety and efficacy may be impacted by these interactions. When utilizing phytosome products, especially if you are on medication, it is important to be aware of potential interactions and get advice from a health-care expert. Take into account the following typical interactions:^[28]

1. **Blood-Thinning Drugs:** *G. biloba*, green tea, and curcumin phytosomes are a few examples of phytosome supplements having anticoagulant qualities that may strengthen the effects of blood-thinning drugs like clopidogrel, aspirin, or warfarin. This could make bleeding more likely.
2. **Drugs that are digested by the liver** may interact with products that contain phytosomes that contain herbs that help the liver, such as milk thistle phytosomes. These interactions may have an impact on how the body breaks down prescription drugs.
3. **Cardiovascular Drugs:** Supplements containing phytosomes for cardiovascular health, such as hawthorn phytosomes, may interact with drugs recommended for heart-related issues, perhaps causing changes in blood pressure or heart rate.
4. **Immunosuppressive drugs:** Products made from phytosomes that contain immune-boosting herbs, like echinacea phytosomes, may interact with immunosuppressive drugs and lessen their efficiency.
5. **Digestive Medicines:** Artichoke phytosomes and other phytosome supplements that promote digestive health may have an impact on the absorption or effectiveness of drugs used to treat stomach issues.
6. **Medication for Diabetes:** Products with phytosomes, such as curcumin phytosomes, may lower blood sugar levels and interact with prescription drugs for diabetes. Because of these interactions, blood glucose levels may change.
7. **Hormonal Drugs:** A few ingredients in phytosome supplements may have an effect on hormone levels. When using these products with hormonal medications, like birth control pills and hormone replacement treatment, care should be taken.
8. **Psychotropic medications:** St. John's wort-containing

phytosome products may interact negatively with psychotropic medications, potentially affecting mood and mental health.

9. **Gastrointestinal drugs:** The efficacy or absorption of gastrointestinal tract medications may be impacted by supplements containing phytosomes, which may have impacting the therapy of acid reflux or ulcers.
10. **Particular Drugs:** Certain phytosome products may interact differently with particular medications, thus it is crucial to address these possible encounters with a medical professional.

Consider the following precautionary precautions to lessen the possibility of interactions:

- a. When talking about your prescription regimen, let your healthcare practitioner know about all the supplements you use, including phytosome products.
- b. Before beginning a new phytosome supplement, consult a physician, particularly if you are currently on medication.
- c. Observe how the supplement is making you feel and abide by the suggested dosage guidelines.

Finally, while phytosome-containing supplements could be good for your health, it is critical to be aware of any drug interactions to ensure both your safety and the effectiveness of your treatment. Consulting a health-care expert is the best course of action for handling these potential interactions.

FUTURE DEVELOPMENTS

Technological advances and new applications in the constantly evolving field of phytosomes are expected in the future. Prospective developments in phytosome technology may concentrate on the subsequent domains:

1. **Tailored Combinations:** Individual health and well-being are becoming increasingly important. Customized phytosome formulations based on a person's genetic composition, lifestyle, and unique health requirements could be the subject of future developments.
2. **Integration of Nanotechnology:** Increasing the transport and absorption of phytosomes may be possible with the help of nanotechnology. This could result in the creation of even more precise and potent phytosome compositions.
3. **Better Skin Delivery:** Technological developments in phytosomes for cosmetics and skin care may lead to increased penetration of bioactive ingredients in anti-aging and skin health products.
4. **Increased Stability and Shelf Life:** Studies to stabilize phytosome complexes and lengthen their shelf life could lead to the development of more dependable and durable goods.
5. **Increased Use in Pharmaceuticals:** Phytosome technology may be used in more areas of the pharmaceutical industry, including the creation of cutting-edge medication delivery methods that could increase the efficacy of

pharmaceuticals.

6. **More stringent quality control requirements** could be implemented in the future to guarantee the reliability and caliber of phytosome goods.
7. **Increasing Emphasis on Safety and Efficacy:** A more evidence-based approach to the usage of phytosome-based medicines may arise from an increasing focus on clinical research to support the safety and efficacy of these products.
8. **Synergistic Combinations:** Adding phytosomes to a formulation along with other complimentary bioactive substances or herbs may provide more potent and focused health remedies.
9. **Artificial Intelligence Integration:** AI and machine learning can be applied to assess personal health data and suggest the best phytosome compositions for customized well-being and health.
10. **Phytosome technology** may lead to advancements in nutraceuticals.
11. **Better Taste and Texture:** By improving the formulation, phytosome supplements may have a better taste and texture that appeals to consumers more.
12. **Consumer Education:** In order to guarantee the best possible health results, future improvements might concentrate on teaching customers about the advantages and responsible usage of phytosome products.
13. **Regulatory Requirements:** As phytosome technology gains more traction, regulatory organizations may set more precise requirements and rules for the manufacturing and sale of goods containing phytosomes.

The future of phytosome technology is expected to be shaped by a confluence of scientific advancement, market demand, and consumer tastes. It is noteworthy that research and development in this subject are still underway. As research on phytosome-based products continues, those interested in learning more should keep up with the most recent findings and speak with medical experts to make well-informed decisions.^[29]

CONSUMER CONSIDERATIONS

There are a few key considerations that consumers should keep in mind while using products based on phytosomes to guarantee secure and efficient supplementation.^[30]

Some important things for consumers to think about are as follows:

1. **Consultation with Health-care Professionals:** It is essential to have a consultation with a health-care professional before to beginning any new supplement, including phytosome products. This is crucial since there could be drug interactions or contraindications if you are expecting, breastfeeding, have underlying medical conditions, or are on any kind of medicine.^[31]
2. **Select premium phytosome goods** from reliable

producers to ensure quality and brand reliability. Seek for goods with third-party testing for potency and purity as well as good manufacturing practices.^[32]

3. Usage and Dose Instructions: Read the product label carefully and adhere to the suggested dosage and usage guidelines. Unless a health-care provider advises otherwise, do not take more than the prescribed amount.
4. Personal Health Objectives: Take your personal health objectives into account when choosing phytosome products. Select the product that corresponds with your needs, as different phytosomes are made to help different elements of health. particular requirements.^[33]
5. Possible Interactions: Be mindful of any interactions you may have with prescription drugs or other supplements you may be taking. Talk to your health-care practitioner about using phytosome products to avoid any negative interactions.
6. Keep an eye out for any side effects by observing how your body reacts to the supplement. Stop using the product and consult a health-care provider if you encounter any negative effects, such as allergies, stomach pain, or strange symptoms.
7. To ensure patient safety, keep phytosome supplements out of the reach of children and pets and store them in a secure location. To prevent unintentional consumption, keep them in their original packaging.^[34]
8. Patience and consistency are important because phytosome products may take some time to show results. To get the desired effects, consistency in use is frequently essential, but be patient and realistic about the timescale for enhancements to health.
9. Avoid Self-Diagnosis: Seek professional medical advice and treatment before using phytosome supplements. When necessary, they can support traditional medical care rather than take its place.
10. Customization: If you have particular health issues or are looking for individualized solutions for your health and fitness, take into consideration bespoke formulations. This could entail seeking advice from medical specialists who can provide specific recommendations.
11. Compliance with Clinical Research: When available, consult clinical research and academic publications to get knowledge about the effectiveness and security of particular phytosome products.
12. Diet and Lifestyle: The advantages of supplementing with phytosomes can be amplified by maintaining a healthy, balanced diet and way of life. For best effects, combine the use of phytosome products with dietary and lifestyle modifications.
13. Consumer Education: Keep yourself updated on the uses and developments of phytosome technology. Knowing the scientific basis for phytosomes, customers can make wise decisions. Customers may maximize possible benefits while lowering risks and negative effects by taking these factors into account when choosing which phytosome products to include in their daily routines for health and wellness.^[35]

CONCLUSION

To sum up, the field of herbal medicine and nutritional supplements has witnessed an inventive and stimulating advancement with the introduction of phytosomes. The phospholipids and plant extracts are molecularly complex to generate these lipid complexes, which may greatly increase the absorption and bioavailability of plant-based bioactive chemicals. New opportunities for enhancing health and well-being are made possible by this breakthrough. There are several health benefits that phytosomes can provide, such as antioxidant defense, liver support, cognitive improvement, and cardiovascular health. Being a beneficial addition to the world of natural therapies and supplements, they have the ability to address a wide range of health conditions. Customers should exercise caution and vigilance when using products containing phytosomes, nevertheless. Personal health objectives, possible drug interactions, and quality concerns should all be taken into account, which supplements to take and how to take them. For supplements to be safe and effective, consultation with medical specialists is crucial. Health-care professionals and consumers may keep up to date on the most recent developments, clinical trials, and customized health solutions as long as phytosome technology research and development is conducted. As herbal medicine and holistic health continue to evolve, the future seems promising for ever more sophisticated and focused phytosome compositions. It is important to emphasize the value of personalized advice and a comprehensive approach to overall health when including phytosome products into a health and wellness routine. Use caution and professional counsel when doing so.

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Source of Support: Nil. **Conflicts of Interest:** None declared.