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Synergistic Fusion: Enhancing Herbal Potency with Phytosome Technology

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ABSTRACT

This review explores the innovative integration of Phytosome technology to augment the effectiveness of herbal compounds. Phytosomes are specialized delivery systems that enhance the bioavailability and absorption of herbal extracts by forming molecular complexes with phospholipids. The review highlights the pivotal role of Phytosomes in improving the solubility and permeability of herbal constituents, thereby facilitating their absorption into the bloodstream. By encapsulating herbal molecules within phospholipid layers, Phytosomes shield them from degradation and metabolic processes, prolonging their presence in the body and enhancing their pharmacological activity. Furthermore, the review underscores the versatility of phytosome technology in enhancing the efficacy of various herbal extracts ranging from traditional remedies to modern herbal supplements. Through case studies and empirical evidence, the paper illustrates how the synergistic fusion of phytosomes with herbal compounds leads to superior therapeutic outcomes compared to conventional formulations.

Moreover, the review discusses the potential applications of synergistic fusion in diverse fields such as pharmaceuticals, nutraceuticals, and cosmeceuticals. It emphasizes the significance of this approach in addressing challenges related to poor bioavilability and inconsistent efficacy encountered with conventional herbal preparations. A comprehensive overview of the synergistic potential of combining phytosome technology with herbal extracts. It elucidates the mechanisms underlying enhanced bioavailability and efficacy, paving the way for the development of novel herbal formulations with optimized therapeutic benefits.

Keywords- Phytosome, Bioavailability, Phytoconstituents, Herbal Extract**.**

I. INTRODUCTION

Most plant elements that are physiologically active are polar or water soluble; nevertheless, limited absorption leads to restricted utilisation of these chemicals, ultimately lowering their bioavailability. Herbal products need to have the right balance between hydrophilic (for absorption into gastrointestinal tract fluid) and lipophilic (to bridge lipid biomembrane balance) to improve bioavailability [1]

Historically, a large portion of the global population has utilised phytomedicines, or preparations made from plants or plant parts, in traditional medicine. In order to determine the chemical makeup of various plant extracts and validate the uses of traditional medicine, several chemical and pharmaceutical investigations have been conducted on them over the past century. Many times, it has been noted that the process of separating and purifying an extract's different components might cause the refined component to lose some of its unique activity [2]. Worldwide, the usage of phytonutrients, also known as nutraceuticals, and herbal medicines is still growing at a rapid pace. Many people are increasingly turning to these products in various

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national healthcare settings to treat a variety of health issues (WHO, 2004). The effectiveness of numerous herbal items has been demonstrated, and therapies utilizing these compounds have shown significant promise. However, many of them, particularly polyphenols, have limited bioavailability, which presents a barrier for medical professionals. (Kulkarni, Pawar, and Awasthi, 2011) [3].

"Phyto" implies plant, and "Some" refers to something that resembles a cell, To create lipid-compatible molecular complexes with improved absorption and bioavailability, this innovative preparation involves adding a standardized plant extract to phospholipids. The important plant extracts are shielded from being broken down by stomach bacteria and digestive enzymes by the Phytosome process, which creates a tiny cell. The creation of cell membranes is attributed to complex chemicals known as phospholipids. Lipid molecules known as phospholipids have two fatty acids bound to the glycerol, with the phosphate group occupying the remaining space [4].

Phytosomes can be beneficially employed in the treatment of both acute and chronic liver diseases that are of toxic metabolic, infectious, or degenerative origin due to their superior pharmacokinetic and pharmacological properties. Along with its usage in medicinal and cosmetic formulations, it also has anti-inflammatory properties. Soy phospholipids and certain plant derivatives are reacted in the right solvent to produce phytosomes. These compounds meet the criteria to be classified as new entities based on their physical-chemical and spectroscopic properties [5].

II. PHYTOSOME TECHNOLOGY

The Italian company Indena s.p.A. created the phytosome technology, which significantly increases the bioavailability of certain phytomedicines by adding phospholipids to standardised plant extract. This process enhances the phytomedicines' absorption and utilization [6]. A team of Italian researchers concentrated on polyphenol preparations that are known to be poorly accessible when taken orally, based on a histochemical finding that certain polyphenols have significant bonding affinity for phospholipids in their intact plant tissue. Usually, they were blends of polyphenols that were isolated from a single plant species, and their bioavailability was significantly enhanced when they were transformed into phytosomes. The polyphenol mixture is chemically combined with a phospholipid preparation, mostly phosphatidylcholine (PC), the primary phospholipid found in living tissues, to create phytosomes. The resultant phytosomes molecular complex is evaluated for bioavailability and effectiveness, often by comparing it directly to its non-phytosomes form. Systematic bioavailability comparisons for the four phytosome preparations under evaluation indicate that oral administration of phytosomes complexation increases blood levels of polyphenol components by a factor of at least 2–6. 3- 7. Since increased bioavailability usually translates into increased effectiveness, phytosome technology has shown to be a game-changer for the therapeutic usability of botanical polyphenols [7]. By creating a small cell using the phytosome technique, stomach fluids and gut microbes are prevented from destroying the plant extract or its active ingredient (Mascarella, 1993) [8].

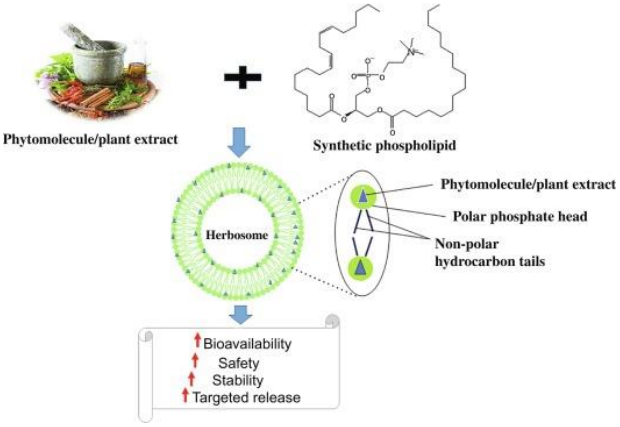

Fig: 1 Phospholipid complexation: A versatile technique for delivery of phytomedicine

III. MECHANISM OF PHYTOSOME TECHNOLOGY

There are two basic reasons for the reduced absorption and bioavailability of polyphenolic components. These main components are several ringed molecules that aren't too little to be absorbed by the diffusion process. The second issue is the low solubility of flavonoid molecules, or the main components of polyphenols, with lipids.

These are the restrictions preventing them from being absorbed via biological membranes. The primary process of phytosome technology is the complexation of polyphenols with phospholipid in a 1:1 or 1:2 ratio, which forms a phytosomal complex with a lipid layer around the components[9].

IV. PHYTOSOME STRUCTURE

Because of their physical and chemical efficiency, these phyto-complexes can be regarded as unique entities since they are created when phospholipid, either synthetic or natural, reacts with certain plant ingredients in the right solvent. The hydrophilic primary active ingredients are connected to the choline portion, whereas the lipid-soluble molecule phosphatidyl is associated to the choline-bound complex. As a result, a lipid combination with improved stability and bioavailability is formed. The polyphenols used as extracts are one class of phytomedicines that is now

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gaining more attention. These comprise the different flavonoid subclasses, among others, and number in the thousands. The biggest barrier to widespread clinical use, however, is that many polyphenols are relatively poorly absorbed when given orally [10].

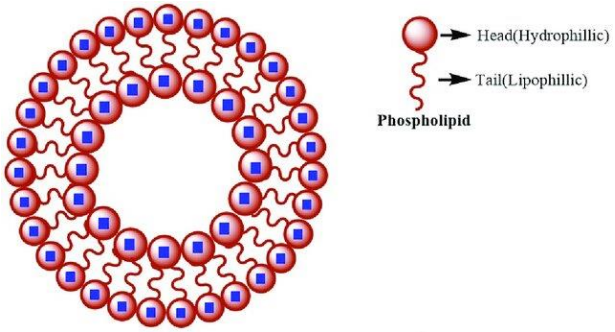

Fig: 2 Structure of Phytosome

V. DIFFERENCE BETWEEN PHYTOSOME & LIPOSOME

Like phytosomes, liposomes are created by combining phosphatidylcholine with a water-soluble material in a certain ratio under predetermined guidelines. The water-soluble material is surrounded by phosphatidylcholine molecules in this instance, no chemical link forms. The water-soluble substance may be surrounded by hundreds or even thousands of phosphatidylcholine molecules. On the other hand, depending on the substance(s) complex, the phytosome process forms a 1:1 or a 2:1 molecular complex between the phosphatidylcholine and the plant components using chemical bonding (hydrogen bonds). Because of this distinction, phytosomes exhibit superior absorption and bioavailability compared to liposomes. In topical and skin care applications, phytosomes have also been demonstrated to be superior to liposomes [11].

VI. METHOD OF PREPARATION OF PHYTOSOMES

Phospholipids are chosen for phytosome preparation from a group that includes swine brain or dermis, phosphatidylcholine, phosphatidylethanolamine, phosphatidyiserine, or soy lecithin. The acyl groups in these phospholipids can be the same or different and are primarily derived from oleic, palmitic, stearic, and linoleic acid. Quercetin, kaempferol, quercretin3, rhamnoglucoside, quercetin-3-rhamnoside, hyperoside, vitexine, diosmine, (+) catechin, (-) epicatechin, apigenin-7-glucoside, luteolin, 3-rhamnoside, luteolinglucoside, ginkgonetine, isoginkgonetine, and bi lobetine are the flavonoids that are chosen [12].

1. Anti Solvent Precipitation Technique:

A known amount of medication, phospholipids, and polymer are added to a round-bottom flask (RBF) and refluxed for two hours at a temperature not to exceed 600C using a designated solvent. After the mixture has been reduced to 5–10 ml, hexane is gradually added while being stirred constantly to produce a precipitate, which is then filtered and stored in a vacuum desiccator for the night. After the precipitate has dried, it is crushed in a mortar and sieved through 100 mesh. Consequently, drug-loaded phytosomes are produced and stored at room temperature in amber-colored glass bottles [13].

2. Solvent Evaporation Technique:

Using alcoholic or organic solvents as the reaction medium, solvent evaporation methods are often used to create the complex of plant extracts or active principles with dietary phospholipids. In the more popular solvent evaporation method, the medication and the phospholipids are combined in a single flask with an appropriate solvent system, like ethanol or tetrahydrofuran. To get the highest yield and drug entrapment, the reaction is allowed to proceed at an appropriate fixed temperature for a predetermined amount of time. Based on a marsupsin-phospholipid complex formulation and a mechanical dispersion-oriented liquid antisolvent precipitation technique, the research was conducted. They marsupsin in double-distilled water and soy lecithin in diethyl ether by sonication. After sonication, the drug solution was gradually added drop by drop to the phospholipid solution. After the final formulation was chilled, analysis revealed that 44% of marsupsin was entrapped in the complex, with 20% of the drug released cumulatively (Sikarwar et al., 2008) [14].

3. Rotary Evaporation Technique:

In a round-bottom glass container, a specified weight of herbal extract and phospholipids were combined with 30 ml of water-miscible organic solvent, such as acetone. The mixture was then stirred for two hours at a temperature lower than 50°C in a rota evaporator. After continuous swirling with a stirrer, a thin layer can be formed. An antisolvent, like n-hexane, can then be added. The resulting phytosome precipitate can be kept in an amber-colored glass container at a predetermined temperature and humidity level [15].

4. Ether Injection Technique:

The technique of injecting ether This method involves dissolving the medication lipid complex in an organic solvent. Vesicles are created by gradually injecting this combination into a hot aqueous agent. Amphiphiles' condition is dependent on concentration. Amphiphiles introduce a monomer state at lower concentrations; but, when concentrations rise, a range of shapes, including round, cylindrical, disc, cubic, and hexagonal types, may emerge [16].

5. Spray Drying Technique:

Phytosomes are new lipid and plant extract combinations. In the process of binding phospholipids such as phosphatidylcholine to the standardised extract of the herb's active components, phytosomes were created. either phosphatidyl serine or phosphatidyl

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ethanolamine via a polar end. One mole of herbal extract and two to three moles of phospholipid, either synthetic or natural, are reacted to create a phytosome. The reaction is conducted in an aprotic solvent, such as acetone or dioxane, from which the complex can be separated by spray drying, lyophilization, precipitation with non-solvents, or precipitation with aliphatic hydrocarbons. The ratio between these two moieties in the complicated development of a phytosome varies between 0.5 and 2.0 moles. A 1:1 ratio between phospholipids and flavonoids is the ideal one [17].

VII. ROLE OF PHOSPHADICOLINE IN PHYTOSME PREPARATION

A significant component in the makeup of cellular and subcellular membranes is phospholipid. They are essential materials for sustaining life's activities. Phosphpolipids are used by the human body as emulsifiers and to improve the absorption of fat-soluble compounds. Moreover, it functions as a surface-active agent in the pericardium, joints, lung pleura, and lung alveoli. Hexane can be used in both mechanical and chemical procedures to extract them from soybeans or egg yolks. The two primary groups of phosphatidylcholines are the hydrophilic choline group and the lipophilic phosphatidyl group. Choline moiet helps with muscular control and enhances memory function. The phosphatidyl group covers the phytoconstituents like a cell form, further protecting the active ingredient from being destroyed by the digestive fluids, while the choline part bonds to the herbal extract [18].

VIII. CHARACTERIZATION OF PHYTOSOMES

Several variables, including physical size, membrane permeability, percentage of entrapped solutes, chemical composition, and amount and purity of the starting materials, influence how phytosomes behave in both physical and biological systems. As a result, the form, size, distribution, percentage of drug capture entrapped volume, percentage of drug released, and chemical composition of the phytosomes are all measured [19].

1. Transition Temperature: A method for figuring out the vesicular lipid system's transition temperature is differential scanning calorimetry (DSC) [20].

2. Visualization: Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) may both be used to see phytosomes [16].

3. Zeta Potential and Particle Size: Dynamic light scattering (DLS) with a computerised inspection system and photon correlation spectroscopy (PCS) can be used to evaluate particle size and zeta potential. Two crucial aspects of complexes that affect their repeatability and stability are their zeta potential and particle size. Particle sizes of phospholipid complexes range from 50 nm to 100 m.

Particle size distribution is measured by the polydispersity index (PDI), a crucial parameter for nanoparticles. The word "monodisperse" refers to particles whose PDI is less than 0.1. The phytosome particles were found to be rather uniform in one investigation including curcumin-phytosomes, with an average size of 131.8 nm and a PDI of 0.191.

If the particles' absolute zeta potential is higher than 30 mV, the particle system will remain extremely stable and be able to stop the particles from aggregating. When the zeta potential readings fall between 20 and 30 mV, the particle system is largely stable. One measure for assessing the stability of a particle system is the zeta potential value. With a zeta potential of -44.5 mV, the curcumin-phytosome system in the previously mentioned work is rather stable [21].

4. Surface Tension Activity Measurement: The Du Nouy ring tensinometer will be used to assess the drug's surface tension activity in an aqueous solution [19].

5. Spectroscopic Evaluation: Spectroscopic analysis validates the formation of a lipid-compatible complex and can be used to analyse phytophospholipid complexation and molecular bonding interactions. Various spectroscopic techniques, including 1HNMR, 13CNMR, 31PNMR, and IR spectroscopy, can be used to analyse the phytosome that has been designed. Examples of these techniques are the following:

1H NMR: NMR spectra can be used to validate the complex formation between the phospholipid and active phytoconstituents. The chemical bonding is described by a notable change in signals that emerge from atoms involved in complex formation in 1HNMR. The development of phytosomes is confirmed by the wide signals originating from phospholipids and phytoconstituents as well as the chemical shift matching to choline's N-methyl [15].

13C NMR: All of the flavonoid carbons are easily visible in the 13C-NMR spectra of (+)-catechin and its stoichiometric combination with distearoylphosphatidylcholine, especially when recorded in C6D6 at ambient temperature. While most of the fatty acid chain resonances maintain their original crisp line form, the signals related to the glycerol and choline part of the lipid (between 60 and 80 ppm) are widened and some are displaced.

All the signals associated with the flavonoid moieties return with heating to 60˚, however they are still quite wide and partially overlap [22].

FTIR: By comparing the spectra of the complex, its constituent parts, and the mechanical mixing, FTIR can verify the spectroscopic assessment of the generated complex. Another useful technique for verifying the stability of the phytosomal complex is FTIR. By comparing the spectrum of the complex in solid form with the spectrum of micro-dispersion in water following

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lyophilization at various intervals, the stability may be verified [4].

IX. PROPERTIES OF PHYTOSOMES

1. Physical and Chemical Properties: A natural substance and naturally occurring phospholipids-such as soy phospholipids-combine to form phytosomes. Such a complex is produced when the substrate and phospholipid in stoichiometric proportions react in the right solvent. The primary phospholipid-substrate interaction is caused by the creation of hydrogen bonds between the polar head of phospholipids, or the phosphate and ammonium groups, and the polar functionality of the substrate, according to spectroscopic evidence. Upon exposure to water, phytosomes take on a micellar shape and develop structures resembling liposomes [23].

When taken orally, the Phytosome formulation enhances systemic bioavailability and boosts the absorption of active substances when applied topically to the skin. A Phytosome will take on a micellar shape in a water medium, generating a structure resembling a liposome. However, there are fundamental distinctions between a liposome and a Phytosome. The active ingredients in liposomes are dissolved in the cavity's centre, making it impossible for the surrounding lipid and hydrophilic material to interact molecularly. Conversely, the Phytosome complex can be likened to a fundamental component of the lipid membrane. Here, the lipophilic guest's polar functionalities interact through hydrogen bonds with the phospholipid's polar head, which consists of phosphate and ammonium groups, creating a distinct arrangement that is verifiable through spectroscopy [24,23].

2. Biological Properties: Phytosomes are sophisticated herbal preparations that outperform traditional herbal extracts in terms of absorption, utilisation, and overall efficacy. Pharmacokinetic investigations or pharmacodynamic testing in experimental animals and human subjects have revealed the higher bioavailability of the phytosome over the non-complexed botanical derivatives [25].

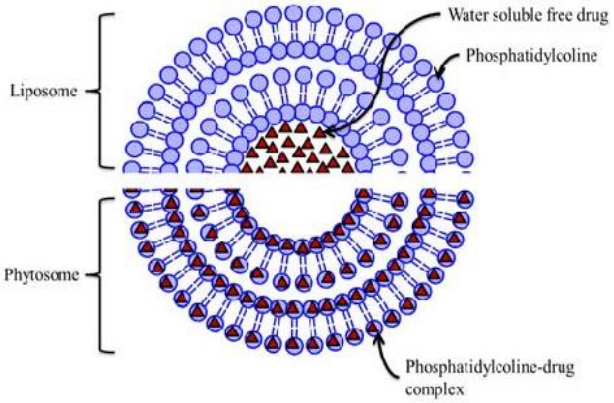

Fig. 3: Types of Phytosome and their type

X. APPLICATION

Antioxidant and Anti-Inflammatory Properties:

Natural antioxidants' limited water solubility limits their bioavailability and potential use in medicine. Our goal was to create a novel phytosome formulation that would boost the bioavailability, antioxidant, and anti-inflammatory qualities of extracts of rosehips (ROSAex) and ginger (GINex). Using the thin-layerhydration approach, the phytosomes (PHYTOGINROSA-PGR) were made from freeze-dried GINex, ROSAex, and phosphatidylcholine (PC) in various mass ratios. Structure, size, zeta potential, and encapsulation efficiency were all described for PGR. The findings demonstrated that PGR is made up of many distinct populations of particles, each of which has a zeta potential of about -21 mV and whose size increases with ROSAex concentration. β-carotene and 6-gingerol had an encapsulation effectiveness of more than 80%. The quantity of ROSAex in PGR is directly correlated with the shielding effect of the phosphorus atom in PC, according to 31P NMR spectra.

In cultured human enterocytes, PGR with a mass ratio of GINex:ROSAex: PC-0.5:0.5:1 exhibited the strongest anti-inflammatory and antioxidant properties. Before LPS-induced systemic inflammation, PGR-0.5:0.5:1 was administered by gavage to C57Bl/6J mice, and their antioxidant and anti-inflammatory properties were investigated. PGR-0.5:0.5:1 bioavailability and biodistribution were evaluated in these animals. PGR caused a 65% reduction in the stomach along with a 2.6-fold increase in 6-gingerol levels in plasma and over 40% in the liver and kidneys when compared to extracts. PGR therapy of systemically inflamed mice resulted in lower levels of proinflammatory TNFα and IL-1β in the liver and small intestine and elevated levels of the antioxidant enzymes paraoxonase-1 and superoxide dismutase-2. PGR did not cause any toxicity in vivo or in vitro. Finally, the GINex and ROSAex phytosome formulations [26].

Anti-Aging Properties: The utilisation of phytosomes as a delivery mechanism has intriguing uses and new avenues for the application of active ingredients in the cosmetic industry. G. The G. Biloba Phytosome has been researched as a potential therapy for superficial capillary blood flow-related skin ageing.G. biloba extracts are used topically to enhance skin microcirculation, and their phospholipid complexes have been shown to enhance peripheral circulation81. Microcirculation activation reduced regressive abiotrophic pinnacular illness, which is linked to chronic venous insufficiency of the breasts and lower limbs, and dystrophic epidermal and dermal modification. Reviewing Phytosome use in functional cosmetics, 82 it has also been claimed that Silymarin Phytosome is used to treat ageing skin [27].

Wound healing Properties: A. Mazumder et al. (2016) investigated the ability of Sinigrin, one of the main glucosinolates found in Brassicaceae plants, to repair

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wounds on HaCaT cells both as a standalone substance and as a phytosome complex. The sinigrin–phytosome combination exhibits 100% wound recovery, but the phytoconstituent on its own only demonstrated 71% healing. Additionally, in the A-375 melanoma cells, sinigrin phytosomes showed increased anti-cancer activity.

The comparative effects of ethanolic extracts of Wrightia arborea leaves and their phytosomes were studied by S. Lakshmi Devi et al. in 2012. While the ethanolic extract by itself could only cure 65.63% of the lesion, the phytosomes showed around 90.40 percent recovery.29 The formed vesicles demonstrated improved wound healing activity (58.7%) and penetration in the cells, collecting near the nucleus, as previously mentioned in the Demir et al. (2014) study [28].

Cardiovascular Properties: According to preliminary research, the PHYTOSOME® of G. biloba L. and the extract from grape seeds are more effective than their simple versions. It was discovered that Ginkgoselect® PhYTOSOME® was 30–60% more effective than Ginkgoselect® in treating peripheral vascular disorders, such as intermittent claudication and Raynaud's illness. A recent validation of Ginkgoselect® PhYTOSOME as a cardioprotective agent was also conducted [38]. Phosphatidylserine complex (Virtiva®) was active at lower dosages than conventional phosphatidylcholine complex (Ginkgoselect® PHYTOSOME®) in the two G. biloba L. PHYTOSOME® complexes, which demonstrated differing cognitive effects.Positive findings were found when Leucoselect® PHYTOSOME® was used to reduce a group of heavy smokers' sensitivity to oxidation and oxidative stress damage in low-density lipoproteins [24].

Hepatoprotactive potential Properties: The majority of phytosomal research is on Silybum marinum because it has superior flavonoids that protect the liver. The flavonoids found in the fruit of the milk thistle plant (Spatharianum, Asteraceae) are known to have hepatoprotective properties. It has been demonstrated that silymarin is effective in treating a variety of liver conditions, such as cirrhosis, hepatitis, fatty infiltration of the liver (chemically and alcoholically produced fatty liver), and bileduct inflammation [29].

In Neurodegenrative Diseases: Using a range of nanotechnological techniques, Langasco et al. investigated the brain delivery of the isoflavone genistein; treatment with phytosomes reduced oxidative stress in PC12 cells (a neuron cell line), and the impact was superior to that of unformulated genistein. After five days of repeated oral administration of the formulation (134 mg/kg/die as curcuminoids equivalent) in rats, curcumin bioavailability was observed to be increased in the hippocampus and frontal lobe. Curcumin showed [12].

Table 1: Available Phytosome Complex Es On The Market [11,30,31,32]

Sr. No.	Phytosomes	Phytoconstituents Complexes	Daily Dose	Biological Activity
1.	Bilberry (irtoselect) Phytosome	Vitamin B12 from Vaccinium myrtillus	_	Antioxidant, Improvement of Capillary Tone.
2.	Silybin Phytosome	Silybin from Silybum marianum	120mg	Hepatoprotective, antioxidant for liver and skin.
3.	Centella phytosome	Terpenes from centella asiatica	_	Brain tonic, Vein and Skin Disorder.
4.	Green Tea Phytosome	Epigallocatechin from *Thea sinesis*	50-100mg	Nutraceutical, systemic antioxidant, anticancer.
5.	Ginkgo select phytosome	Flavonoids from ginkgo biloba	120mg	Anti aging, Protects Brain & Vascular Liling.
6.	Grape seed (Leucoselect) phytosome	Procyanidins from vitis Vinifera	50-300mg	Nutraceutical, Antioxidant, Anticancer.
7.	Olive oil Phytosome	Polyphenols from Oleaeuropaeaoil	_	Antioxidant, anti-inflammatory, antihyperlipidemic.
8.	Ginseng phytosome	Ginsenosides from panax Ginseng	150mg	Nutraceutical, Immunomodulator
9.	Echinacea purpurea	Echinacea purpurea (L.) Moench - Root	_	Immunomodulator
10.	Curcumin (Merinoselect) Phytosomes	Polyphenol from Curcuma Longa	200-300mg	Cancer Chemo preventive Agent Improved the oral bioavailability of curcuminoids, and that the plasma.
11.	Casperome	Banksia serrata gum Resin	_	Higher systemic availability and improving tissue distribution of boswellic acids.
12.	Crataegus	Vitexin-2″-O-rhamnoside from	_	

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	phytosome	hawthorn flower		Antioxidant
13.	Echinacea phytosome	Echinacosides from Echinacea angustifolia	_	Neutraceutical, immunomodulator
14.	Virtiva	Ginkgo flavonglycosides, ginkgolides, bilobalide from Ginkgo biloba leaf	_	Vasokinetic
15.	Visnadex	Visnadin from Amni visnaga umbel	_	Vasokinetic
16.	18ß-glycyrrhetinic acid phytosome	18ß-glycyrrhetinic acid from licorice rhizome	_	Soothing
17.	Hawthorn phytosome TM	Flavonoids from Crataegus sp.	_	Food product, hypertension and other heart diseases
18.	PA2 phytosome	Proanthocyanidin A2 from horse chestnut bark	_	Anti-wrinkles, UV protectant
19.	Sericoside phytosome	Sericoside from Terminalia sericea bark root	_	Anti-wrinkles
20.	Escin ß-sitosterol phytosome	Escin ß-sitosterol from horse chestnut fruit	_	Anti-oedema

XI. FUTURE PRESPECTIVES

A well-known technique for improving the pharmacokinetic and pharmacodynamic profiles of phytoconstituents with significant therapeutic promise but low absorption is complexing herbal active components with dietary phospholipids. The phytophospholipid complex was first created for cosmetic purposes, but it has now undergone careful investigation and development to serve as a new medication carrier with systemic effects. The study has to be expanded to address the problems of production method, stability, and real clinical superiority of these drug delivery systems, even if the field is being extensively investigated.Thorough examination of the published literature indicates that a great deal of research is being done on herbal extracts and active components in the area of innovative drug delivery. Numerous plant extracts and their components are well recognised to have important pharmacological or health-improving properties. For the effective administration of these plant components or extracts, researchers should focus more on carrier systems, as they can greatly increase the therapeutic potential of delivery systems. Phospholipids can be complexed with certain plant ingredients/extracts to facilitate the effective and systematic administration of herbal constituents. For the formulation of phytophospholipid complexes, the solvent evaporation approach has been a commonly employed traditional method. The process, however, entails a number of laborious processing steps, and the final product's quality in terms of particle size, morphology, and hygroscopicity frequently depends on the drying technique—which hasn't been optimised in any of the studies—used to remove the residues.The supercritical fluid approach can be used to get around the shortcomings of conventional technologies since it allows for more exact control over particle size and dispersion at relatively mild temperatures. The systemic bioavailability is further enhanced by the consistency of the particle size. For delicate drug candidates, the CO2 supercritical fluid offers steady, inert conditions that are free of hazards. This claim is not well-supported by study data, and more investigation is required into the effects of supercritical fluid technology formulation optimisation on the in vivo parameters of herbal medications. The majority of research has focused on the conventional 1:1 molar ratio between medicines and phospholipids. Nonetheless, a number of studies indicate that a drug to phospholipid ratio other than 1:1 results in a more superior product in terms of pharmacological and physiological characteristics.The yield of phytophospholipid complexes exhibited considerable variation across studies, ranging from approximately 25% to over 90%. This variation was ascribed to distinct formulation factors, including drug-to-phospholipid ratio, temperature, and treatment duration, all of which have been demonstrated to impact the carrier system's yield. Scientists also face challenges in drying phytophospholipid complexes and achieving a practical yield. The yield is not readily repeatable and varies depending on the preparation process used. The quality and quantity of the result are determined by variables such processing time, the ratio of plant extract to phospholipid, and the temperature maintained throughout the process. The utilisation of statistical techniques can aid in the design of specific ratios between plant extracts and phospholipids, in addition to various other parameters like drying time and temperature, to attain optimal trapping efficiency and a superior product with the desired drug release profile [27].

XII. CONCLUSION

The integration of phytosome technology represents a promising strategy for enhancing the potency of herbal compounds. The lipid-based delivery

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systems of phytosomes contribute to improved bioavailability, thereby maximizing the therapeutic benefits of herbal formulations. Through synergistic fusion, the combination of herbal extracts with phytosome technology offers a valuable approach to optimize the absorption and efficacy of phytoconstituents. As research in this field advances, the potential for developing highly potent and bioactive herbal products continues to grow, opening new avenues for the utilization of phytosome technology in herbal medicine.

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