International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 1 Jan-Feb 2024, pp: 1816-1829 www.ijprajournal.com ISSN: 2249-7781

Phytosome: An emerging trend for delivery of phytopharmaceuticals

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Submitted: 18-02-2024 Accepted: 26-02-2024

ABSTRACT: A novel delivery method called "Phytosome technology" permits phospholipid and water-soluble phytoconstituent to interact. The phospholipid molecule has two fat-soluble tails and a water-soluble head. Because of these dual solubility, the phospholipid acts as an emulsifying agent,When combined with herbal extract, the phytosome enhances the bioavailability of lipid-soluble drugs by promoting faster and more effective absorption. As a result, this article provides a brief overview of a novel drug delivery system and vesicular drug delivery systems, Introduction ofPhytosome, advantages and disadvantages,properties, methods of Preparation ,characterization and applications.

KEYWORDS: Novel drug delivery system,Vesicular drug delivery system,Phytosome, phytoconstituent , bioavailability.

I. INTRODUCTION

1.1.Novel drug delivery system

We refer to this innovative approach as unique medicine delivery systems. Because of recent developments in our knowledge of the pharmacokinetic and pharmacodynamicsbehaviour of pharmaceuticals, novel drug delivery systems, have been developed. NDDS are carriers that maintain the drug concentration in the therapeutic range for a longer periods of time.

There are several benefits that novel medication delivery systems offer over conventional drug delivery methods.

- An extended duration of time can be achieved by maintaining the ideal therapeutic drug concentration in the blood or tissue.
- It is possible to accomplish pre-determined release rates over a longer length of time.
- The duration of a medication with a short half-life could be extended
- It may be possible to get rid of side effects by focusing on the site of action.

Novel approaches to medication administration Many drug delivery systems have been developed, some of which are still in the development stage, with the goals of minimizing drug degradation or loss, preventing negative side effects, improving drug bioavailability, and also favouring and facilitating the accumulation of the drug in the required bio-zone (site).

There are a number of recently developed carriers that have shown to be beneficial for controlled and targeted drug delivery. Examining the different terms used to characterize the several main types of novel drug delivery systems is essential.

Prolonged or constant (Zero-order) release is provided by sustained or regulated drug delivery systems, respectively, at the therapeutically effective levels in the circulation, to provide pharmacological action at a predetermined rate. Localized drug delivery systems deliver drugs by spatially or temporally regulating drug release (often rate-limiting) close to the target.Drug action is provided by rate pre-programmed drug delivery systems, which manipulate the release of drug molecules by controlling their molecular diffusion[1]. Novel drug delivery is a new area of pharmaceutical science that is method for targeted drug delivery systems [2]. inventive vesicular drug delivery methods seek to transfer the active ingredient to the site of action and administer the medication at a rate determined by the body's needs throughout the course of treatment. To accomplish targeted and regulated medication delivery, a

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variety of innovative vesicle-based delivery with a range of administration techniques have been designed.[3]

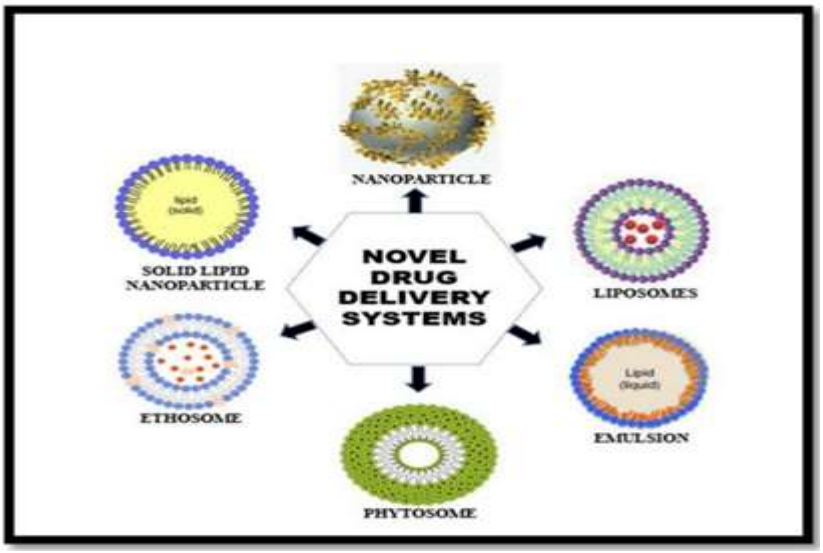

Figure 1. Novel drug delivery systems

II. VESICULAR DRUG DELIVERY SYSTEM

Innovative vesicular drug delivery systems aim to release the medication at a rate that is dictated by the body's requirements at the point of treatment, while also guiding the active ingredient to the site of action. The vesicular Systems are formed when certain amphiphilic building components come into touch with water. They consist of one or more concentric lipid bilayers assembled in a highly ordered fashion. Vesicles can be made with a broad range of amphiphilic building blocks. These vesicles, which Bingham initially identified as having a biological origin in 1965, were termed Bingham bodies. Lipid vesicles have grown inprominence, as have vesicles used for drug delivery. were found to be beneficial in membrane biology, genetic engineering, diagnostic techniques, andimmunology.

The delivery of drugs to the infection site is made possible by the vesicular delivery system, which reduces medication toxicity while having no negative side effects. Vesicular drug delivery lowers therapy costs by increasing drug bioavailability, particularly for poorly soluble medicines. Hydrophilic and lipophilic medicines can be incorporated by them both. Liposomes, Niosomes, Sphinosomes, Transferosomes, and Pharmacosomes are a few of the novel ways utilized to transport pharmaceuticals via vesicular systems. Drug toxicity is reduced with no negative side effects because of the Vesicular Delivery System, which provides a dependable delivery system to the infection site. By boosting medication bioavailability, vesicular drug delivery reduces therapy expenses, especially when dealing with poorly soluble medicines[4].

Site specificity, enhanced bioavailability, and stability are just a few of the goals that have been accomplished by lipid particle systems, which were created to entrap a variety of therapeutic molecules[5].

Drug permeability across the layer of corneum blockage is still possible with liposomes, Transferosomes, Ethosomes, and Niosomes. Due to the medications' easy passage through the skin, permeability enhancers raise the skin's permeability. Ethosomes may improve permeability through the stratum corneum barrier, in contrast to traditional liposomes, which are mostly used to deliver medications to the skin's upper layers. When compared to regular liposomes, ethosomes exhibit a significantly higher transdermal flux and speedy penetration through the skin layers.[6]

III. TYPES OF VESICULAR DRUG DELIVERY SYSTEM

Lipoidal biocarriers: Phytosomes, Emulosomes, Enzymosomes,Sphingosomes, Transferosomes ,Pharmacosomes, Liposomes,Ethosomes

Non-lipoidal biocarriers: Bilosomes, Aquasomes, Niosomes [7-8]

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IV. PHYTOSOMES

4.1. Historical background

The Indena Company (Milan, Italy) created the first phytosomes in the late 1980s with the intention of complexing pharmaceuticals to phospholipids to boost their bioavailability [9].Traditional medicines have been used to manage health since the beginning of time, The majority of bioactive plant components, including terpenoids, flavonoids, phenolic glycosides, and anthocyanins, are hydrophilic in nature and highly polar in nature. This nature causes a significant barrier to drug absorption since the highly lipophilic GI membrane prevents the passage of highly water soluble substances over it, which ultimately leads to low bioavailability.The amount and rate at which the active component, such as a medicine or metabolite, enters the bloodstream to demonstrate clinical efficacy and lower the dose are known as bioavailability. A medication must have adequate lipophillicity and hydrophillicity in order to be bioavailable[10].

Phytosomes is the combination of the two words phyto and some, both of which relate to plants. The stoichiometric reaction of phospholipid with standardized extracts of polyphenolic compounds in a non-polar solvent produced Phytosomes, which are similar to cells.this type of strategy called as Pharmacosomes and phytosomes [11].

Phytomedicines are regularly used by most people on the planet. Throughout the past century, phytochemical and phytopharmacological studies have been conducted on plant extracts and products to determine their chemical composition and support the advice of traditional medicine. Polar or water soluble substances like flavonoids, tannins, and terpenoids make up the bulk of a plant's active ingredients[12].The phytosomes, also called as the phytolipid delivery system, serves as a connectionbetween the convectional and innovative delivery systems [13].When taken internally or applied topically, the majority of the active components in the herbal medicines produced are primarily hydrophilic molecules with little efficacy and poor absorption. Furthermore, the medications have poor bioavailability due to their increased molecular size, which hinders passive diffusion absorption, and their low lipid solubility, which restricts their ability to cross the lipid-rich outer membranes of the enterocytes.In order to address this problem, a higher dosage needs to be given, and a unique drug delivery system may help to enhanced effectiveness and decrease the side effects of herbal ingredients and herbs [14].

Phytosomes are a patented technology that increase the bioavailability and absorption of lipid compatible molecular complexes. Phytosomes are liposome-like vesicles in which phospholipid [15]. Active plant components soluble in water are complexed to boost their stability. Phospholipids employed in the creation of phytosomes include phosphatidylcholine, soy phospholipid, and others. Phospholipids simply wrap the water-soluble components in phytosomes, greatly improving their bioavailability [16]. Phytosomes are a component that can modify the nature of flavonoids into lipophilic phospholipids by converting hydrophilic environmental conditions into lipophilic conditions in accordance with cell membrane environmental conditions [17].

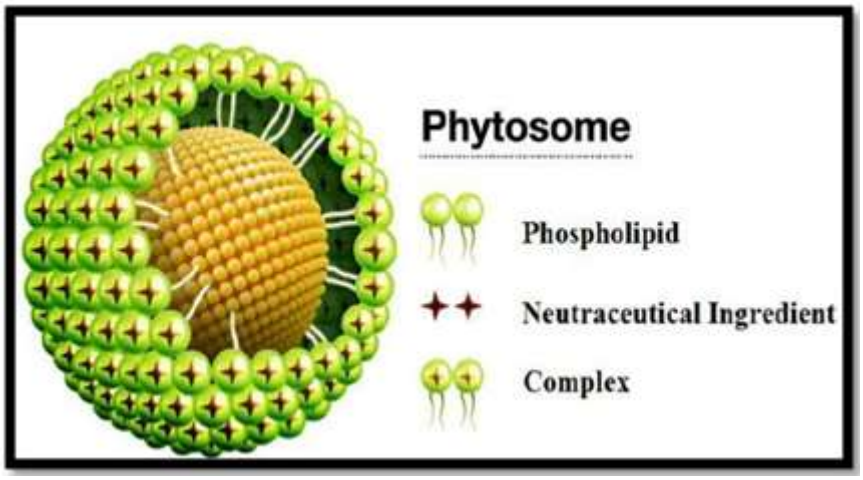

Figure 2. Phytosome

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4.2. Advantages

- Phytosome, which are more accessible botanical extracts, deliver faster and better absorption in the intestinal system, leading to a much stronger therapeutic effect. This is because they are complex with phospholipids, which dramatically increases bioavailability.
- The non-lipophillic botanical extract is permeated by phytosome to improve intestinal lumen absorption.
- Less dosage may be required to produce the desired results as the absorption of the active components improves.
- higher lipid profiles and more skin penetration, phytosomes are commonly employed in cosmetics.
- Unlike liposomes, phosphatidylcholine molecules and phytoconstituents create chemical connectionsThe stability profile of phytosomes is better.
- Phytosomes are more effective at trapping drugs.
- Phosphatidylcholine serves as a transporter, but it also has nutritional benefits and hepatoprotective properties.
- Systemically targeting herbal drugs can be accomplished by phytosomes because they can readily go from a hydrophilic environment to the lipid-friendly environment of the enterocyte cell membrane and subsequently into the cell.
- Phytosome formulations enable the topical use of phytoconstituents for cosmetic and other purposes [18-19].

4.3. Disadvantage

- They reduce their absorption when given orally or topically.
- Phytoconstituents is quickly eliminated from phytosome.
- A stability issue [20].

V. PROPERTIES

5.1. Physical properties

Phytosomes are produced by reacting the standardized plant extract as the substrate with a stoichiometric amount of phospholipid. The spectroscopic data indicates that the phospholipid-substrate interaction is caused by a hydrogen bond formed between the polar head (phosphate and ammonium group) and the polar functionalities of the substrate [21].Phospholipid-substrate interaction results from the creation of hydrogen bonds between the polar head of the phospholipid and the polar functions of the major components [22].

5.2. Biological properties

Phytosomes are innovative natural formulations that improve the effectiveness and absorption of herbal ingredients, leading to superior results when compared to conventional herbal medications. They improve the bioavailability of active plant ingredients, ensuring more effective utilization by the body, essentially making herbal treatments more efficient.Phytosomes have been proven to be more effective than regular herbal extracts through studies in both animals and humans. They're innovative complexes that get absorbed and used by the body more efficiently [23].

VI. DIFFERENT ADDITIVES USED IN THE FORMULATION OF PHYTOSOMES

6.1. Phospholipid

The lipids found in large quantities in plant seeds and egg yolks are called phospholipids. Based on the kind of backbone they have, they can be classified into two main categories: glycerophospholipids and sphingomyelins. Phosphatidylcholine , phosphatidylethanolamine, phosphatidylserine , phosphatidic acid, phosphatidylinositol, and phosphatidylglycerol are further glycerophospholipids. These compounds are essential to many biological processes and cell membranes. Phospholipids can also be produced industrially.More than half of the lipid weight in biological membranes has been made up of phospholipids with glycerol. The C3 OH group creates a ester of phosphoric acid.

6.2. Phyto-active constituents

Phyto-active constituents are active component in herbal extracts. Some are hydrophilic and can’t pass through cell membranes (e.g., hesperidin), while others are lipophilic and can’t dissolve in digestive fluids (e.g., curcumin). Phytophospholipid complexes help solubilize lipophilic ones and improve membrane penetration for hydrophilic ones, while also protecting them from degradation.

6.3. Solvent

To create phyto-phospholipid complexes, researchers have experimented with a range of solvents. Methylene chloride, cyclic ethers,

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aromatic hydrocarbons, and halogen derivatives were among the aprotic solvents they typically used. But these days, effective complex formation is more often achieved using protic solvents like methanol and ethanol [24-25]

VII. METHODS OF PREPARATION

7.1. Thin layer rotary evaporator method(Rotary evaporation process)

Drug,Phospholipids, and polymer, in precisely the right amounts can be dissolved in a specific solvent and swirled for three hours at a temperature not to exceed 40°C in a revolving flask with a spherical bottom. It is possible to add n-hexane to a thin layer of the sample and agitate itcontinuously using a magnetic stirrer. Collecting and storing the precipitated phytosomes at room temperature can be done by placing them in an amber-coloured glass bottle [26-27].

By using a thin layer rotary evaporator vacuum approach, phytosome vesicles were created. In a round-bottom flask, the phytosomal complex was combined with anhydrous ethanol. A rotary evaporator had the flask fastened to it. At roughly 60˚C, the solvent will evaporate and leave a thin film surrounding the flask. Phosphate buffer at a pH of 6.8 hydrates the film, and the lipid layer peels off to form a suspension of vesicles in the phosphate buffer. Prior to characterisation, the phytosomal suspension will be refrigerated for a full day [28].

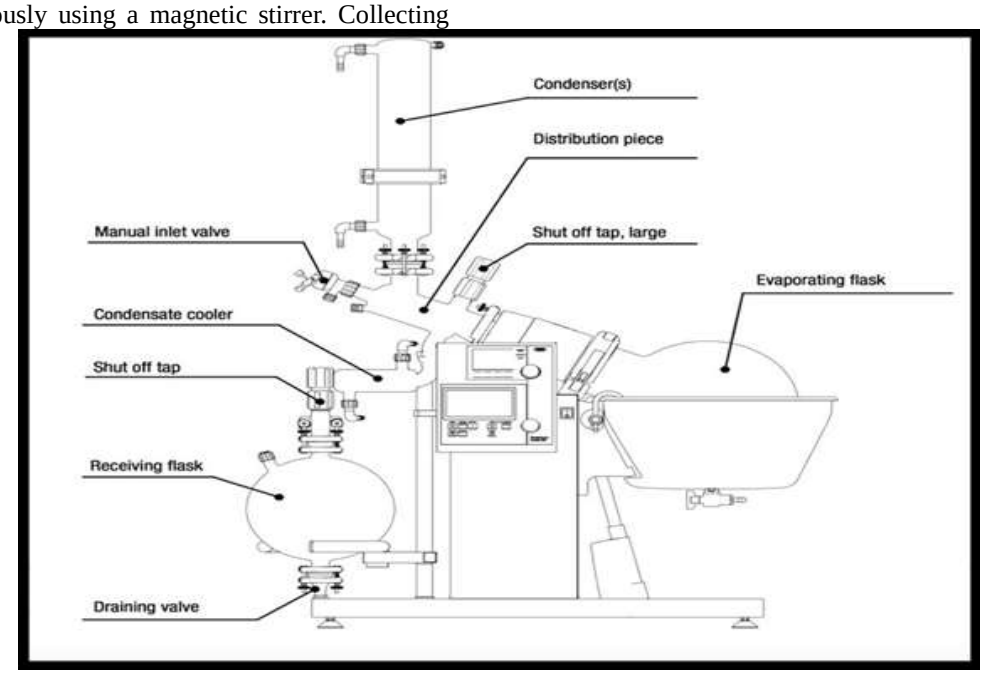

Figure 3. Rotary evaporation process

7.2. Anti-solvent precipitation process(Salting out method)

A particular quantity of phospholipids and herbal extract are refluxed with 20 ml of organic solvents, such as acetone, under specific experimental conditions, below 50°C, for two to three hours. Precipitates are produced after the reaction mixture is filtered and reduced to a minimum of 10 milliliters and a low-polarity solvent, such as n-hexane, is added while stirring. Desiccators are used to stored filtered precipitates[29]. A mortar is used to crush the dried precipitate, which is then sieved through #100 meshes. An amber-colored glass bottle containing the dried precipitate phytosome loaded can be kept at room temperature [30].

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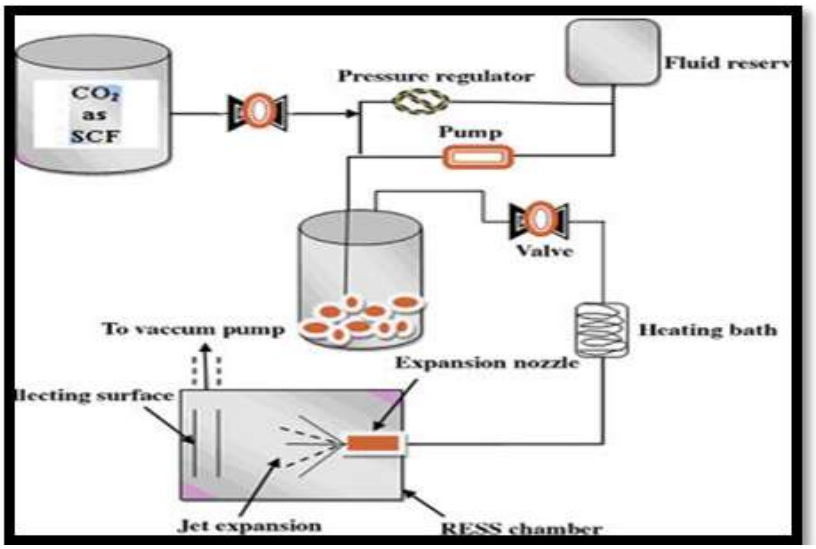

Figure 4. Anti-solvent precipitation process

Phytosomes develop via anti-solvent precipitation. Both the bioactive chemical and the phospholipid dissolve in an organic solvent. The organic solvent is entirely extracted at reduced pressure and temperature using a rotating vacuum evaporator. A thin layer of phospholipid and conjugated bioactive material would form in the flask with a circular bottom. Hexane is used to completely remove the solvents from the thin layer, producing a precipitate that is gathered, filtered, and kept in vacuum desiccators for a full day. In a mortar, crushed dry precipitate is sieved through #100 meshes. The powdered substance was kept at room temperature in a glass bottle with an amber colour until it was time to rest [31].

The phospholipid and In an aprotic solvent, phytoconstituents are dissolved.and let to stand overnight. The resulting complex is then separated from the solvent by precipitating it out of a non-solvent such as n-hexane [32].

7.3. Solvent evaporation method

A 100 ml round-bottom flask containing the recommended amount drug and soy lecithin was refluxed for two hours at 50°C by using 20 ml of acetone. It is required to concentrate the mixture to 5–10 ml in order to obtain the precipitate, which was passed through filters and collected.The dried precipitation of phytosome complexes were kept in an amber-colored glass bottle at room temperature [33].

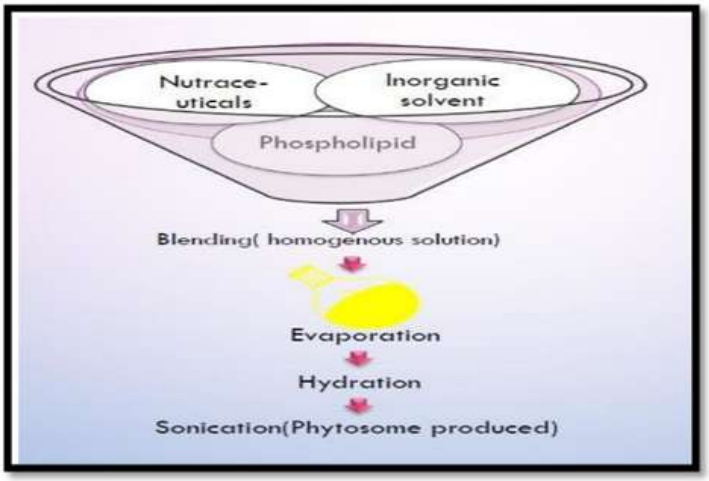

Figure 5. Solvent evaporation method

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The solvent evaporation method can be used to produce the phytosome. Phosphatidylcholine is dissolved at 40°C by magnetic stirring in 100 mL of a non-polar solvent, such as chloroform. Before adding the active phytoconstituent to the phosphatidylcholine-chloroform solution, it is dissolved in 20 milliliters of a non-polar solvent, like methanol. The clear solution is vacuum-dried at 60 °C after a two-hour stirring period. It is then stored overnight in a 40 °C vacuum. Subsequently, the leftover material is gathered, ground, and sealed. This causes a pale yellow powder known as a phytophospholipid complex to accumulate [34].

This process involves reacting lipids dissolved in an organic solvent with plant extracts in an aqueous phase. The phytoconstituents to be encapsulated are mixed with an aqueous solution and then slowly added drop by drop of phospholipids soluble in diethyl ether. Complex creation follows the removal of the solvent, which induces the development of cellular vesicles. The concentration of phytosomes determines their shape; at less concentrated levels, amphiphiles in the mono state form; at larger concentrations, on the other hand, a variety of structures with unique morphologies, such as spherical, cylindrical, disc, cube-shaped, or hexagonal vesicles, are obtained [35].

7.4. Solvent ether-injection process

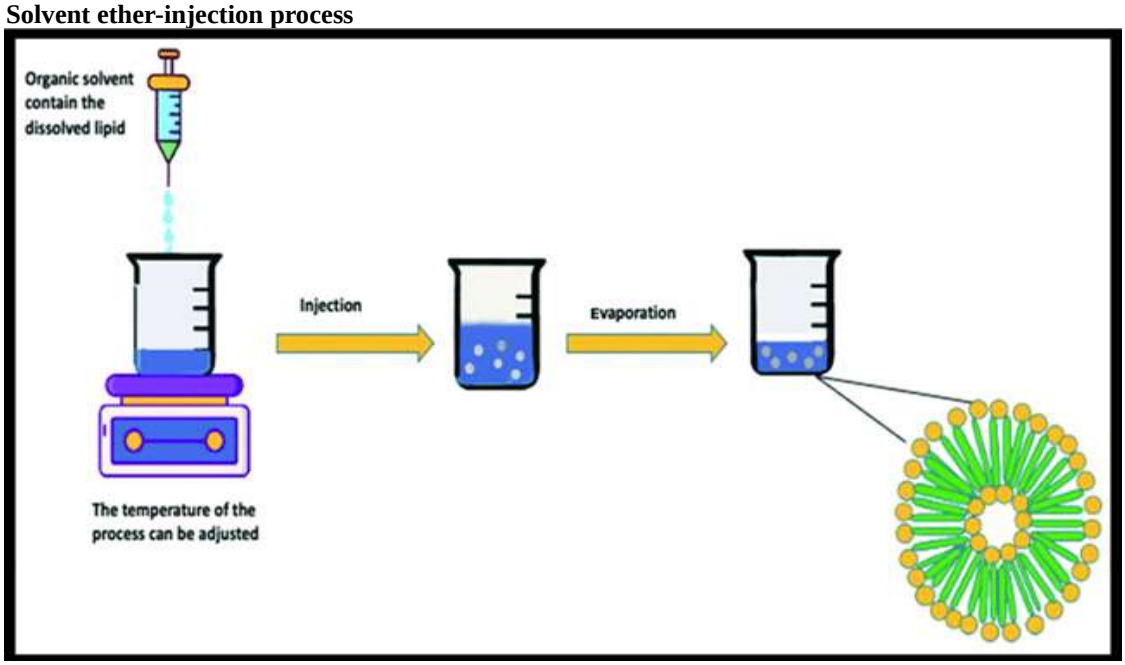

Figure 6. Solvent ether injection process

7.5. lyophilization technique

DSN completely dissolved in DMSO. After that, the SPC solution was dissolved in 1.5% weight/volume of t-butyl alcohol and added to the DSN solution (2.5% w/v). The combination was then mixed for 3 hours with a stirrer that was magnetic until complex formation takes place. The compound was then separated by lyophilization. Following four hours of freezing at -80°C, the vials were put in a Cryodos-50 lyophilizerat a condenser temperature of -70°C. at -40°C shelf temperature and 40 mbar of pressure was used for the lyophilization process. A second day was dedicated to secondary drying at 25°C. Following removal of the samples from the freeze drier, the resultant DSN:SPC complex (yield 90.4%, w/w) was stored at 4°C in a desiccator over P2O5. The influence of several formulation factors, including co-solvent type (ethanol,acetone,methanol,TBA and chloroform) drug:phospholipid ratio (1:1, 1:2, and 1:4), andSPC type (Lipoid® S75, Lipoid® S100and Lipoid® S PC-3), was assessed for the specified Developing method [36].

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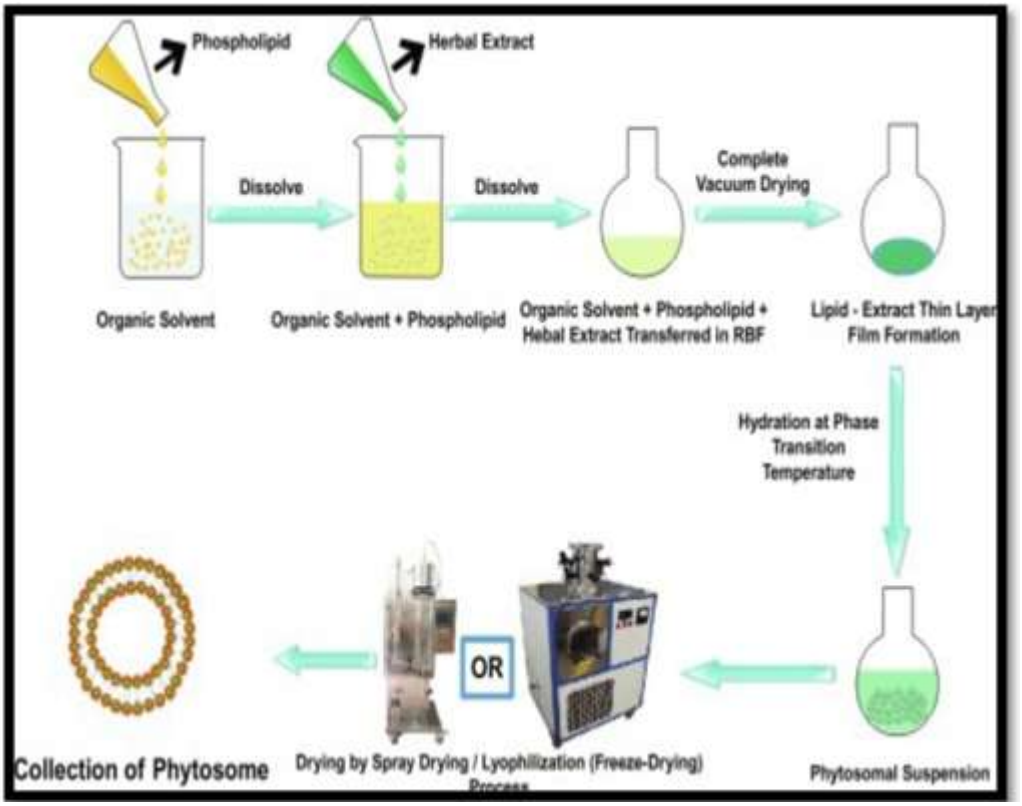

Figure 7. Lyophilization process

VIII. PHYTOSOME CHARACTERIZATION

A variety of variables including as physical size, membrane permeability, proportion of entrapped solutes, and chemical makeup of the generating materials, have a significant impact on the behaviour of phytosomes in physical and biological systems. The phytosomes' physical features were described using the following characterization methods.

8.1. Transition temperature

The vesicular lipid system's transition temperature can be determined with differential scanning calorimetry. Scanners for differential S Calorimetry using DSC: A sample was heated to 300 °C in a nitrogen environment at a rate of 5 °C per minute while enclosed in an aluminium crimp cell. The offset temperature of the peak transition was identified [37].

8.2. Entrapement efficiency

A phytosomal formulation's entrapment efficiency assessed by using the technique called as ultracentrifugation [38].

Capacity to load drugs and entrap them Extraction of the phytosome and free medicine was made possible by centrifuging the phytosomal complex at 10,000 rpm at 4°C for 90 min. It is possible to calculate the amount of free medication present by using UV spectroscopy. It is feasible to calculate the proportion of drug entrapment, as demonstrated [39-40]

Entrapment efficiency (%)= Weight of total drug – Weight of free Drug x 100
Weight of total drug

8.3. Zeta potential and vesicle size

Dynamic light scattering (DLS) and photon correlation spectroscopy (PCS) can be used to measure the vesicle size and zeta potential, of course.One can assess particle size and zeta potential through utilizing dynamic light scattering (DLS) with an automated inspection system and photon correlation spectroscopy (PCS) [41].Two crucial aspects of complexes that affect their repeatability and stability are their zeta potential and particle size. phospholipid complexes particle size range from 50 nm to 100 m.

If the particles zeta potential is more than 30 mV, the particle system is very stable and

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capable of preventing particle aggregation. In the region of 20-30 mV, the particle system exhibits relative stability when the zeta potential values are observed.With a zeta potential of -44.5 mV, the curcumin-phytosome system in the previously mentioned work is rather stable.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 131.8 nm and a PDI of 0.191 [42].

8.4. measuring surface tension activity

A Du Nouy ring tensiometer can be used to measure the surface tension activity of a drug in an aqueous solution using the ring methods.

8.5. Visualization

Viewing can be done using both scanning electron microscopy (SEM) and transmission electron microscopy (TEM). It is possible to see phytosomes using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). An image captured by transmission electron microscopy of a soybean phytosome revealed smooth, spherical vesicles devoid of any signs of particle aggregation. Regarding the drug's distribution and internal environment within the phospholipid mesh, TEM research can offer valuable insights. The phytosomal vesicles' size can be ascertained by TEM at a 1000x magnification. Scanning electron microscopy (SEM) was used to evaluate the phytosome surface, however the results revealed no crystalline particles or impurities. The phytosomes' spherical shape is verified by the spherical bulge on their surface [43].

8.6. Drugs content

For the quantitative determination of drugs, high performance liquid chromatography is used.

8.7. Vesicle stability

can be assessed by monitor changes in the vesicle's size and composition over time.TEM tracks structural changes and DLS calculate the mean size [44].

8.9. Spectroscopic analysis

Spectroscopic analysis are frequently used to investigate the corresponding interaction between phospholipid and phytoconstituents. The commonly used techniques are follow :The FTIR By comparing the spectra of the complex, its constituent parts, and the mechanical mixing, The produced complex's spectroscopic evaluation can be confirmed by FTIR. FTIR is another helpful method for determining the phytosomal complex's stability. The stability can be confirmed by comparing the solid-state complex's spectra with the water-phase micro-dispersion spectrum after lyophilization at different intervals

FTIR

FTIR analysis will be used to investigate the phospholipid structure and chemical stability of the medication. To create pellets, the phytosomal medication will be mashed with potassium bromide at a pressure of 600 kg/cm2. There will be 400–400 cm in the scanning field [45].

IX. IN VITRO AND IN-VIVO EVALUATION

9.1.In vitro evaluation

Considering the potential medicinal effects of the physiologically active phytoconstituents in the phytosomes ,models of in-vivo and in-vitroevaluations are chosen. For instance, the phytosomes' capacity to scavenge free radicals and operate as an antioxidant can be used to measure their in-vitro antihepatotoxic activity.

9.2. In-vivo evaluation:

To determine antihepatotoxic activity in vivo, the effect of produced phytosomes on animals against hepatoxicity provoked by alcohol, thioacetamide, or paracetamol can be studied. The in vivo safety evaluation methodology is described based on studies conducted on the skin sensitivity and recognition of a brand-name product called glycyrrhetinic acid-Phytosomeointment [46].

X. APPLICATIONS

10.1. Antioxidant Properties

A study performed in 1993 found that Silipide, a phytosome of Silybum marianum, has antioxidant properties. Through lipid peroxidation inhibition and reactive oxygen species scavenging, it shielded rat livers against oxidative damage caused by CC14 and paracetamol. Silipide demonstrated anti-lipoperoxidant properties in humans when it was given to patients with Hepatitis C and Hepatitis B Virus for two months. It also decreased serum malondialdehyde levels by 36% and liver function markers related to cell destruction [47].

Anti-oxidative properties of metal phytosomes that are created by encasing calendula

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officinalis extract. Using vero cell lines, an in vitro cell-based antioxidant assay was used to analyse reactive oxygen species. The study's findings showed that the plant extract and au-loaded phytosome had cell viability percentages of roughly 35% and 81%, respectively [48].

10.2. Cardioprotective Properties

Ginkgo biloba Phytosomes (GBP) were investigated for their protective effects against cardiotoxicity enhanced by isoproterenol (ISO) in rats. ISO caused myocardial infarction in rats, and GBP treatment at doses of 100 mg and 200 mg/kg for 21 days significantly reduced cardiac damage.

BP lowered enzymes serum marker, reduced peroxidation of lipid, and increased levels of antioxidants like SOD, GSH, CAT and GR in the heart. This suggests that GBP's cardioprotective effects against ISO-induced damage are likely due to enhancing endogenous antioxidants and inhibiting lipid peroxidation in cell membranes [49].

Improved total antioxidant capacity, raised physiological defences, protection against ischemia/reperfusion-induced heart damage, and protective effects against atherosclerosis—which offers substantial cardiovascular system protection—have all been demonstrated in numerous studies on grape seed phytosomes. Another study found that rabbits treated with grape seed phytosomes had far less aortic plaque in their carotid arteries and aortas than the control group, which received a similar regimen of conventionally standardized grape seed extract. Research has demonstrated revealed in isolated rats, ginkgo phytosomes are better than conventional standardized extracts in avoiding myocardial ischemia [50].

10.3. Transdermal application

One common flavonoid found in Ruta graveolens is rutin, which has a number of health benefits. Rutin phytosomes were discovered to be more effective than free Rutin at entering the stratum corneum, the outermost layer of the skin. Rutin alone had a skin absorption of only 13%, however rutin phytosomes had a 33% skin rate of absorption [51].Additionally, advantages in capillary permeability, vascular protection, and UV radiation protection were demonstrated by a phytosomal complex of plant extracts and saponins from Panax ginseng M. Based on these results, phytosomal formulations have potential uses in skin care.These formulations have moisturizing effects on the skin, increasing its elasticity by stimulating fibroblasts in the dermal layer, promoting proteoglycan and collagen synthesis. They can be used orally in capsules, syrups,tablet or solutions to treat conditions like capillary fragility, inflammation and other areas where saponins are known to be effective[52].

10.4. Wound healing

Sinigrin, a glucosinolate from Brassicaceae plants, was examined for its wound healing properties. The Sinigrin-phytosome complex demonstrated 100% wound recovery in HaCaT cells, while Sinigrin alone achieved only 71% healing[53].

10.5. Hepatoprotective properties

Ginkgoselect Phytosome® can provide protection against hepatotoxicity in rats induced by rifampicin. Its antioxidant and free radical scavenging qualities seem to be connected to this defence [54].When it comes to Diphenyl-1-picrylhydrazyl (DPPH) radicals, mangiferin (MF) shown strong scavenging action. This promotes liver regeneration in a variety of liver lesions. Comparing ordinary MF with MF herbosomes, an ex vivo study showed a significant increase in MF absorption. Total bilirubin, alkaline phosphatase, serum glutamate oxaloacetate transminase , and serum glutamate pyruvate transminase were all much lower in MF herbosomes than in plain MF, according to an in vivo investigation evaluating the hepatoprotective potential of MF herbosomes. Superoxide dismutase, catalase, reduced glutathione, and superoxide dismutase (Malymarin) were all much higher in MF herbosomes than in plain MF, which was also comparable to the standard drug Silymarin [55].Andrographolide (AN), which is derived from Andrographis paniculata Linn, has been traditionally used to treat aa various conditions, such as fever, inflammation, tonsillitis, tuberculosis ,pharyngitis, , pneumonia, , pyelonephritis, laryngitis and hepatic impairment. When compared to its phytosome dose, the drug's equimolar dose exhibits lower absorption and higher serum levels of SGPT ands SGOT, suggesting its hepatoprotective properties [56].

10.6. Antiaging Properties

To prevent premature aging, researchers used coconut water (rich in cytokinins), Aloe vera extract (contains vitamins E and C and phenol compounds), grape seed extract (contains potent

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antioxidants and proanthocyanidins), vitamin E (for its antioxidant properties), and jojoba oil (moisturizing and similar to human skin oil). They tried creams and gels but found them less effective. Instead, they created phytosomes by binding these herbal extracts to phosphatidylcholine, which nourishes the skin. Phytosomes have a unique structure with both water-soluble and fat-soluble parts, making them better absorbed for skin treatment, anti-aging, and skin health [57].

10.7. Enhanced bioavailability

Evodiamine, a compound found in Evodia rutaecarpa, has various beneficial effects like anti-tumor, anti-inflammatory, pain relief, anti-obesity, and temperature regulation. It can combat tumors by slowing their growth, triggering cell death, and reducing their spread. Creating Evodiamine phytosomes enhances its dissolution rate, absorption, and duration of action, leading to better bioavailability. This prolonged effect results from the slow release of the drug from the phytosome, which can also help bypass the liver, reducing first-pass metabolism. Phytosome loaded Evodiamine bioavailability is more than theregular Evodiaminebioavailability [58].Indena S.P.A. is the owner of a European patent covering the enhanced bioavailability of novel phospholipid complexes derived from olive fruits or leaf extract. Because pure olive fruit extract has so numerous phytochemical propertiessuch as anti-hypertensive, diuretic, anti-atherosclerotic, antioxidant, and hypoglycemic effectsit was utilized to make Oleaselect phytosomes. greater percentages of hydroxytyrosolandhomovanillyl alcohol) have been observed in the Oleaselect phytosome-treated group compared to the other phytosome-treated group, suggesting an elevated oral bioavailability [59].

XI. CONCLUSION

One patent-protected technique is phytosomes. It is possible for phytosomes to travel from hydrophilic environment into the lipid-rich enterocyte cell membrane and from the cell to the circulation.Research has demonstrated that vesicles are highly promising cellular delivery systems for a variety of therapeutic phytochemicals. Phytosomes are vesicular drug carriers that improve the absorption, bioavailability, and general stability of bioactive compounds by forming a complex between the phytochemicals and phospholipids.Phytomedicine has been used for thousands of years, and phytosomes hold great promise for delivering traditional herbal remedies in a more modern and efficient manner. Denaturation and bioavailability are always significant concerns for herbal products. There are many of innovative techniques available in NDDS form. Despite these strategies, phytosomes are the most innovative ways for herbal medications to deal with this kind of issue. The pharmacokineticsand pharmacotherapeutics of herbal medications have been enhanced by these administration methods. The phospholipids utilized in the manufacture of phytosomes have their positive impacts on the body, and the process of creating phytosomes is simple to understand and reproducible.

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International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 1 Jan-Feb 2024, pp: 1816-1829 www.ijprajournal.com ISSN: 2249-7781

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