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HERBOSOMES: HERBO-PHOSPHOLIPID COMPLEX AN APPROACH FOR ABSORPTION ENHANCEMENT

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ABSTRACT

There are many herbal extracts having excellent bioactivity in vitro but less in vivo because of their poor lipid solubility and improper size of the molecule or both, which result in poor absorption and bioavailability of herbal extract or constituents from herbal extract and they destroyed in the gastric fluids when taken orally. Herbosome is the novel emerging technique applied to phyto-pharmaceutical for the enhancement of bioavailability of herbal extract for medicinal applications. Herbosomal formulations have enhanced absorption rate, producing better bioavailability than conventional herbal extract. Since they have improved pharmacological and pharmacokinetic parameters. Herbosomes absorption in GIT is greater resulting in increased plasma level than individual component. Herbosome act as bridge between novel delivery system and conventional delivery system. Phospholipids molecule acting as vital carrier made up of water soluble head and two fat soluble tails, due to this nature they possess dual solubility and thus acting as an effective emulsifier.

Key Words: Polyphenols Enhanced Bioavailability, Phospholipid, Herbal Extract, Phospholipid-Phytoconstituent complex.

INTRODUCTION

Over the last century, phyto-chemical science and phyto-pharmacological science established the numerous botanical products with various biological activities and health promoting benefits. Phytomedicines, complex chemical mixture prepared from plants, have been used in medicine since ancient times and continue to have widespread popular use (Kidd, 1996). Most of the biologically active constituents of plants are polar or water soluble molecules. However, water soluble phytoconstituents like flavonoids, tannins, glycosidic aglycones etc. Are poorly absorbed either due to their large molecular size which cannot be absorb by passive diffusion or due to their poor lipid solubility thus limiting their ability to pass across the lipid rich biological membranes,

resulting poor bioavailability when taken orally or applied topically. Often isolation and purification of individual components from whole herbal extract lead to partial or total loss of therapeutic activity, the natural synergy become lost which is due to chemically related constituents in herbal extract. The chemical complexity of the crude or partially purified extract seems to be essential for the bioavailability of the active constituents. Standardization was developed to solve this problem.

As standardized extracts became established, poor bioavailability often limited their clinical utility. Extracts when taken orally some constituents may get destroyed in the gastric environment (Pandey *et al.*, 2010). Many approaches have been developed to improve the oral bioavailability, such as inclusion by solubility and bioavailability reasons enhancers, structural modification and entrapment with the lipophilic carriers or different novel delivery systems like liposomes, marinosomes, niosomes and photosomes which can enhance the rate of release as well as the capacity to cross the lipid rich biomembranes (Uchegbu *et al.*, 1998; Moussaoui *et al.*,

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2002). Phospholipids based drug delivery systems have been found much hopeful and promising for the effective and efficacious herbal drug delivery.

Approach of Herbosomal Technology

Herbosomes, complex of natural active ingredients and phospholipid(s), increase absorption of herbal extracts or isolated active ingredients when applied topically or orally. Herbosomes are cell like structures which result from the stoichiometric reaction of the phospholipids (phosphatidylcholine, phosphatidylserine etc.) With the standardized extract or polyphenolic constituents in a non-polar solvent, which are better absorbed, utilized produce better results than conventional herbal extracts. Phospholipids are the main building blocks of life and are one of the major components of cellular membranes. In general, they are considered as natural digestive aid and carriers for both polar and non-polar active substances (Singha *et al.*, 2011). Most of phospholipids possess nutritional properties, like phosphatidylserine which acts as a brain cell nutrient, phosphatidylcholine which is important in liver cell regeneration. Soya phospholipids have lipid reducing effect with hydrogenated phospholipids serve as basis for preparation of stable liposomes because of their amphiphilic character herbosomal formulations enhance the bioavailability of active phytochemical constituents as they are now permeable and can cross the lipid rich biomembranes quite easily, and the active components of the herbal extracts are well protected from destruction by digestive secretions and gut bacteria. Therefore, with help of herbosomal preparations, the amount of standardized herbal extracts or phytoconstituents administered in body through several routes are required in fewer amounts for good therapeutic activity. With the advancements in science, the herbosomes have gained importance in various fields like pharmaceuticals, cosmeceuticals and nutraceuticals in preparing different formulations such as solutions, emulsion, creams, lotions, gels, etc. Several companies involved in production and marketing of herbosomal products are Indena, Jamieson natural resources, Thorne Research, Natural factors, and Natures herb (Singha *et al.*, 2011). Sometimes it is difficult to understand the basic difference between liposome's and herbosomes.

Mechanism of Herbosome Formation

The polyphenolic constituents of plant extracts lend themselves quite well for direct binding to phosphatidylcholine. Herbosomes are formed from the reaction of a stoichiometric amount of the phospholipid like phosphatidylcholine with the standardized extract or polyphenolic constituents like simple flavonoids in aprotic solvent (Bombardelli *et al.*, 1989). phosphatidylcholine is a bifunctional compound, the phosphatidyl moiety being lipophilic and the choline moiety being hydrophilic in

nature. Specifically the choline head of the phosphatidylcholine binds to these compounds while lipid soluble phosphatidyl portion comprising the body and tail which then envelopes the choline bound material. Hence, the Phytomolecules produce a lipid soluble molecular complex with phospholipids called as phyto-phospholipid complex. Phytomolecules are anchored through chemical bonds to the polar choline head of phospholipids, as can be demonstrated by specific spectroscopic techniques (Bombardelli *et al.*, 1991). Often Precise chemical analysis indicates the unit Herbosome is usually a flavonoid molecule linked with at least one phosphatidylcholine molecule. The result is a little microsphere or cell is produced (Murray *et al.*, 2008).

Merits of Herbosomes

1. Herbosomes show better stability as chemical bond is formed between phospholipid molecule and phytoconstituent(s).
2. Dose of phytoconstituents is reduced due to more bioavailability of phytoconstituents in the complex form.
3. Duration of action is increased.
4. Herbosomes are simple to manufacture.
5. Phytoconstituents complex with phospholipids are more stable in gastric secretion and resist the action of gut bacteria.
6. Enhanced permeability of phytoconstituents across the biological membranes.
7. Absorption of lipid insoluble polar phytoconstituents through different routes shows better absorption, hence shows significantly higher therapeutic effects
8. Phosphatidylcholine used in the formation of herbosomes, besides acting as a carrier also possess several therapeutic properties and gives the synergistic effect.
9. Drug entrapment is not a problem with Herbosome as the complex is biodegradable (Kumar *et al.*, 2010; Kidd 2002; Bhattacharya *et al.*, 2009; Patel *et al.*, 2009).

Physical Properties of Herbosomes

- Herbosome has lipophilic substances with a clear melting point.
- Average size of herbosome range is 50 nm to a few hundred μm .
- They are easily soluble in non-polar solvents, insoluble in water and moderately soluble in fats.
- Liposomal like structures of miscellar shape are formed when herbosome are treated with water (Patel *et al.*, 2009).

Chemical Properties of Herbosomes

On the basis of their physicochemical and spectroscopic data, it has been shown that, the phospholipid-substrate interaction is due to the formation

of hydrogen bond between the polar heads of phospholipids (i.e. phosphate and ammonium groups) and the polar functional groups of substrate. In herbosomes the active principle is anchored to the polar head of phospholipids, becoming an integral part of the membrane (Patel *et al.*, 2009; Darshan *et al.*, 2007; Sindhumol *et al.*, 2010).

Method of Herbosomes Preparation

Herbosomes novel complexes which are prepared by reacting from 3-2 moles but preferably with one mole of natural or synthetic phospholipids, like phosphatidylcholine, phosphatidylethanolamine or phosphatidylserine with one mole of component like flavonoids, either alone or in the natural mixture in aprotic solvent such as dioxane or acetone. The herbosome complex can be then isolated by precipitation with non solvent such as aliphatic hydrocarbons or lyophilization or by spray drying. In the complex formation of herbosomes the ratio between these two moieties is in the range from 0.5-2.0 moles. The most preferable ratio of phospholipids to flavonoids is 1:1 (Bombardelli *et al.*, 1987).

Naringenin-PC complex was prepared by taking naringenin with an equimolar concentration of phosphatidylcholine (PC). The equimolar concentration of PC and naringenin were placed in a 100 ml round bottom flask and refluxed in dichloromethane for 3 hrs on concentrating the solution to 5-10 ml, 30 ml of n-hexane was added to get the complex as a precipitate followed by filtration. The precipitate was collected and placed in vacuum desiccators (Semalty *et al.*, 2009).

Preparation of silybin-phospholipids complex using ethanol as a reaction medium. Silybin and phospholipids were resolved into the medium, after the organic solvent was removed under vacuum condition, and a silybin-phospholipids complex was formed (Yanyu *et al.*, 2006).

The required amount of the drug and phospholipids were placed in a 100 ml round-bottom flask and dissolved in anhydrous ethanol. After ethanol was evaporated off under vacuum at 40°C, the dried residues were gathered and placed in desiccators overnight, then crushed in the mortar and sieved with a 100 mesh. The resultant silybin-phospholipids complex was transferred into a glass bottle, flushed with nitrogen and stored in the room temperature (Xiao Yanyu *et al.*, 2006).

Mechanical Dispersion method is used for the preparation of marsupin-phospholipid complexes. Phospholipid is dissolved in suitable solvent and active ingredient is added drop by drop while sonicating the solution phospholipids complex is sometimes prepared under reflux and stirring conditions to affect complete interaction (Sikarwar *et al.*, 2008).

Curcumin phospholipid complexes are prepared by adding the phospholipids to the ethanol solution of the hydro alcoholic extract of turmeric rhizomes, under reflux

and with stirring. Prepared complex called Herbosome can be isolated by precipitation with non-solvent, lyophilisation, and spray drying or vacuum drying (Maiti *et al.*, 2007).

Characterization and Evaluation of Herbosomes

The physical size, membrane permeability, percentage of entrapped solutes, percentage drug released and chemical composition as well as the quantity and purity of the starting material of Herbosomes, are some factors which may influence physical and biological system.

Microscopic and Other Techniques

1) Visualization: Visualization of herbosomes can be achieved using Transmission Electron Microscopy (TEM) and by Scanning Electron Microscopy (SEM) electron microscopic techniques (Maghraby *et al.*, 2000).

2) Vesicle size and Zeta Potential: The particle size and zeta potential can be determined by Dynamic light scattering (DLS) using a computerized inspection system and Photon correlation spectroscopy (PCS) (Fry *et al.*, 1978).

3) Entrapment efficiency: The entrapment efficiency of a drug in herbosomes can be measured by the ultracentrifugation technique (Liposomes, 1990).

4) Transition temperature: The transition temperature of the vesicular lipid systems can be determined by differential scanning calorimeter (Cevc *et al.*, 1995).

5) Surface Tension Activity Measurement: The surface tension activity of the drug in aqueous solution can be measured by the ring method in a Du Nouy ring tensiometer (Berge *et al.*, 1997).

6) Vesicle stability: The stability of vesicles can be determined by assessing the size and structure of the vesicles over time. The mean size is measured by DLS and structural changes are monitored by TEM (Dayan *et al.*, 2002).

7) Drug content: The amount of drug can be quantified by a modified high performance liquid chromatographic (HPLC) method or by a suitable spectroscopic method. (Facino *et al.*, 1994).

To confirm the formation of a complex or to study the reciprocal interaction between the phytoconstituent and the phospholipids, the following spectroscopic methods are used (Semalty *et al.*, 2006).

1) ¹H-NMR: The NMR spectra of (+)-catechin and its stiochiometric complex with distearoylphosphatidylcholine have been studied by Bombardelli *et al.* (Bombardelli *et al.*, 1989) in polar solvents, there is a marked change of the ¹H-NMR signal originating from the atoms involved in the formation of the complex, without any summation of the signal peculiar to the individual molecules. The signals from the protons belonging to the flavonoid are to be broadened that the proton cannot be relieved. In the

phospholipids, there is broadening of all the signals while the singlet corresponding to the N-(CH₃)₃ of choline undergo an uplift shift. Heating the sample to 60°C results in the appearance of some new broad bands, which correspond mainly to the resonance of the flavonoid moiety.

2) ¹³C-NMR: In the ¹³C-NMR spectrum of (+)-catechin and its stoichiometric complex with distearoylphosphatidylcholine, particularly when recorded in C₆D₆ at room temperature, all the flavonoid carbons are clearly invisible. The signals corresponding to the glycerol and choline portion of the lipid (between 60-80ppm) are broadened and some are shifted, while most of the resonance of the fatty acid chain retains their original sharp line shape. After heating to 60°C, all the signal belonging to the flavonoid moieties reappear, although they are still very broad and partially overlapping.

3) FTIR: The formation of the complex can be also be confirmed by IR spectroscopy by comparing the spectrum of the complex with the spectrum of the individual components and their mechanical mixtures. FTIR spectroscopy is also a useful tool for the control of the stability of herbosomes when micro-dispersed in water or when incorporated in very simple cosmetic gels. From a practical point of view, the stability can be confirmed by comparing the spectrum of the complex in the solid form (herbosomes) with the spectrum of its micro-dispersion in water after lyophilization, at different times. In the case of simple formulations, it is necessary to subtract the spectrum of the excipients (blank) from the spectrum of the cosmetic form at different times, comparing the remaining spectrum of the complex itself.

Biological Evaluation

In-Vitro and In-Vivo Evaluation

Models of in vitro and in vivo evaluations are selected on the basis of the expected therapeutic activity of the biologically active phytoconstituents present in the Herbosome (Hikino *et al.*, 1984). For example in-vitro antihepatotoxic activity can be assessed by the antioxidant and free radical scavenging activity of the herbosomes.

For assessing antihepatotoxic activity in-vivo, the effect of prepared herbosomes on animals against thioacetamide, paracetamol or alcohol induced Hepatotoxicity can be examined (Wellington *et al.*, 2001; Kidd, 1996). Skin sensitization and tolerability studies of ointment, a commercial product, describe the in vivo safety evaluation methodology (Delgi *et al.*, 2004). The bioavailability of a silybin- phospholipid complex was studied in dog models to examine the pharmacokinetic parameters of this new complexed form (Filburn *et al.*, 2007).

Recent Research on Improved Bioavailability with Phyto-Phospholipid Complexation

P. Mukherjee & Co-associates (2009) enhanced Oral Bioavailability and Antioxidant Profile of Ellagic Acid by Phospholipids. In the research they studied that Ellagic acid (EA) is potent antioxidant with several nutritional benefits but reported to have rapid elimination from the body. To overcome this limitation they developed novel dietary formulation of EA with phospholipid. To investigate the effect of this complex on carbon tetrachloride induced liver damage in rats. The antioxidant activity of complex and free EA was evaluated by measuring various enzymes in oxidative stress condition. The complex significantly protected the liver by restoring the activity of superoxide dismutase, catalase and liver glutathione, and thiobarbituric acid reactive substances with respect to carbon tetrachloride treated group. The complex provides better protection to rat liver than free EA at same dose. The serum concentration of EA obtained from complex was higher than of pure EA and complex maintained effective concentration for longer time in serum. Result shows better hepatoprotective activity of EA complex (Murugan *et al.*, 2009).

Sharma A. & Co-associates (2010) were studied the Complexation with phosphatidyl choline (PC) as a strategy for absorption enhancement of boswellic acid (BA). Boswellic acid oleo gun resin of *Boswellia serrata* were reported to be effective as anti-inflammatory, hypolipidemic, immunomodulatory, and anti-tumor. Pharmacokinetic studies of boswellic acid reveal its poor absorption through the intestine. The objective of their study was to enhance bioavailability of boswellic acid by its complexation with phosphatidylcholine. They characterize the boswellic acid-phosphatidylcholine (BA-PC) complex and studied the ex-vivo drug absorption of (BA-PC) complex and plain BA. Anti-inflammatory activity of the complex was compared with boswellic acid in carrageenan-induced paw edema in rats. Hypolipidemic activity was also evaluated in Triton-induced hyperlipidemia. The complex was also converted into vesicles (phytosomes) and compared with other vesicular systems (liposome's and niosome) by evaluating its anti-inflammatory effect. The results of ex-vivo study show that BA-PC complex has significantly increased absorption compared with boswellic acid, when given in equimolar doses. The complex showed better anti-inflammatory and hypolipidemic activity as compared to BA. Among all vesicular systems phytosomes showed maximum anti-inflammatory activity. Enhanced bioavailability of the BA-PC complex may be due to the amphiphilic nature of the complex, which greatly enhance the water and lipid solubility of the boswellic acid. The present study clearly indicates the superiority of complex over boswellic acid, in terms of better absorption, enhanced bioavailability and improved pharmacokinetics (Sharma *et al.*, 2010).

R. Pathan & Co-associates (2011) prepared an embelin-phospholipid complex (EPC) formulation in an

attempt to enhance the water solubility and characterize the new developed formulation. Embelin, due to water insolubility causes poor bioavailability by oral route.

To improve the bioavailability and prolong its duration in body system, its phospholipid complexes were prepared by a simple and reproducible method. EPC was formulated by mechanical dispersion method using ethanol as a reaction medium. The complex formation was confirmed by carrying out FTIR, ¹H-NMR, XRD, DSC and microscopical studies. Solubility and in vitro studies were carried out to ascertain the solubility and dissolution pattern of free and complexed embelin. Water solubility of embelin was improved from 3-42 1g/mL in the prepared complex. n-Octanol solubility were also altered for free embelin and EPC from 2.3 to 391g/mL Unlike the free embelin, which showed a total of only 19% drug release at the end of 120 min, EPC showed 99.80% release at the end of 120 min of dissolution study in distilled water (Pathan *et al.*, 2011).

N. Gupta & Co-associates (2011) were enhancing the absorption of grape seed polyphenols by complexation with phosphatidyl choline (PC). Grape seed polyphenols (GPP) are reported to have various biological effects along with strong antioxidant potential. Pharmacokinetic studies of GPP reveal its poor absorption through the intestine. Complex of GPP was prepared and characterize on the basis of solubility, melting point, DSC, and IR. Everted intestine sac technique was used to study *ex vivo* drug absorption of GPP-PC complex and plain GPP. Pharmacokinetic studies were performed in rats and the hepatoprotective activity of GPP-PC complex was also compared with GPP and GPP-PC physical mixture in isolated rat hepatocytes. And the results of *ex vivo* study show that the GPP-PC complex has significantly increased absorption compared with GPP, when given in equimolar doses. The complex showed enhanced bioavailability, improved pharmacokinetics, and increased hepatoprotective activity as compared to GPP or GPP-PC physical mixtures. Enhanced bioavailability of GPP-PC complex may be due to the amphiphilic nature of the complex, which greatly enhance the lipid miscibility of GPP (Gupta *et al.*, 2011).

I. Kusumawati & Co-associates (2011) prepared the phospholipid complex of *Kaempferia galangal* rhizome extract using phosphatidylcholine was intend to improve the bioavailability of its constituents. Characteristics and analgesic activity of the extract and its marker compound, ethyl *p*-methoxycinnamate (EPMS), were compared to their phospholipid complex (F. Extract and F.EPMS). Characteristics of the free form and their complexes were analyzed by DTA and SEM. Their analgesic activity was determined using writhing test. The complex showed a better analgesic activity compared to the free form of both extract and EPMS at an equivalent dosage (Kusumawati *et al.*, 2011).

R. Kuamwat & Co-associates (2012) studied that Gallic acid and its derivatives are a group of naturally occurring polyphenols antioxidants which have recently been shown to have potential health effects but when administered orally it shows poor absorption because of less lipophilicity. To overcome this limitation, they developed gallic acid- phospholipids complex in different ratio to improve the lipophilic properties of Gallic acid. The physicochemical properties of the complex were analyzed by ultraviolet-visible spectrometry (UV), infrared spectrometry (IR) and differential scanning calorimetry (DSC), solubility, dissolution, etc. the result showed that Gallic and phospholipids in Gallic-phospholipids complex were joined by non-covalent bond and did not form a new compound and observed that complex was an effective scavenger of DPPH radicals and showed the strong antioxidant activity (Kuamwat *et al.*, 2012).

U. Bhandari & Co-associates (2012) studied the anti-apoptotic effect of gymnemic-acid phospholipid complex (GPC) pretreatment in wistar rats with experimental cardiomyopathy. They studied that cardiomyocyte apoptosis is one recent cause in heart failure and also investigate the potential cardioprotective effect of GPC on myocardial apoptosis and cardiac function in doxorubicin (DOX)-induced cardiomyopathy model in rats. They observed that pre-treatment with GPC significantly reduce DOX-induced cardiac toxicity including improvement of hemodynamic variables and heart weight loss to body weight ratio, decreased serum Ca²⁺ level and LDH level, myocardial caspase -3 level ,increased Na⁺/K⁺ ATPase level, decreased myocardial TBARS levels and elevated antioxidant enzyme levels were compared to pathogenic control group, further the anti-apoptotic effect of GPC by was studied by prevention internucleosomal DNA laddering & attenuation of histopathological perturbation by DOX. The observation demonstrates that GPC might serves as a cardioprotective formulation (Pathan *et al.*, 2012).

S. Sandhya & Co-associates (2012) Performed Preclinical studies of a novel polyherbal phyto-complex hair growth promoting cream which was incorporated with the aq. extracts of *Trichosanthes cucumerica* (T.cucumerica) Linn and *Abrus precatorius* (A.precatorius) Linn. In the experimental study, extraction of both plants, chemical testing of both extract, then extract were made into phyto-phosphatidylcholine complex, finally preparation of formulation and then evaluation of cream containing polyherbalphyto-complex. Preclinical studies showed that formulated 2% polyherbalphyto-complex hair growth promoting cream was an effective hair growth promoter as the results were analogous to that of minoxidil 2%.it was observed that percentage of hair follicles in the anagen phase increased considerably which predicts that the formulation can be used in alopecia (Sandhya *et al.*, 2012).

Table 1. Difference between Herbosomes and Liposomes

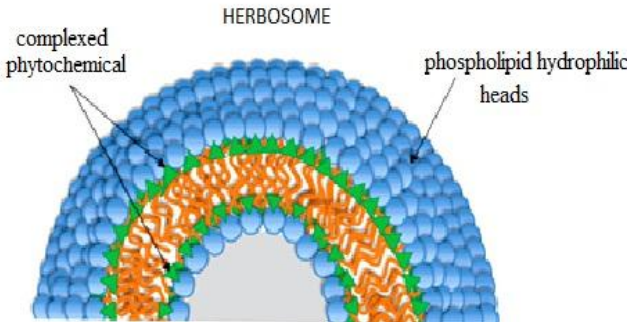
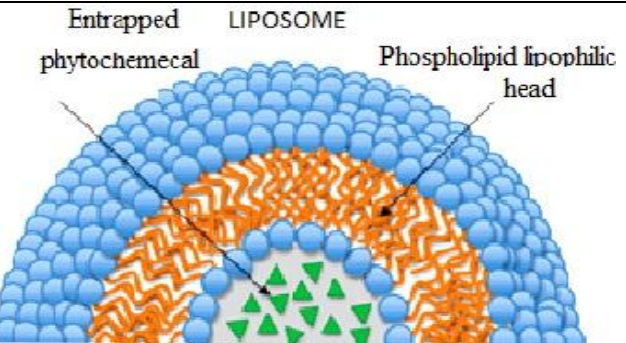
HERBOSOMES	LIPOSOMES
 <p>HERBOSOME</p> <p>complexed phytochemical</p> <p>phospholipid hydrophilic heads</p>	 <p>LIPOSOME</p> <p>Entrapped phytochemical</p> <p>Phospholipid lipophilic head</p>
<p>In herbosomes active chemical constituents molecules are anchored through chemical bonds to the polar head of phospholipid.</p> <p>In herbosomes, phosphatidylcholine and the individual plant compound form a 1:1 or 2:1 complex depending on the substance.</p>	<p>In liposomes, the active principle is dissolved in the medium of activity or in the layers of the membrane. No chemical bonds are formed.</p> <p>In liposomes, hundreds and thousands of phosphatidylcholine molecules surround the water soluble molecule.</p>

Table 2. Some Patented Technologies of Herbosomes

Title of patent	Innovation	Patent No	Reference
Phospholipid complexes of olive fruits or leaves extracts having improved bioavailability	Phospholipids complexes of olive fruits or leaves extracts or compositions containing it having improved bioavailability	EP/1844785	Franceschi <i>et al.</i> , 2007
Compositions comprising Ginkgo biloba derivatives for the treatment of asthmatic and allergic conditions	Compositions containing fractions deriving from Ginkgo biloba, useful for the treatment of asthmatic and allergic conditions	EP1813280	Pierro, 2007
Fatty acid monoesters of sorbityl furfural and compositions for cosmetic and dermatological use	Fatty acid monoesters of sorbityl furfural selected from two diff series of compounds in which side chain is a linear or branched C3 -C19 alkyl radical optionally containing at least one ethylenic unsaturation least one ethylenic unsaturation	EP1690862	Bertelli <i>et al.</i> , 2006
Cosmetic and dermatological composition for the treatment of aging or photo damaged skin	Composition for topical treatment of the skin comprises a substance that stimulates collagen synthesis and a substance that enhances the interaction between extracellular matrix and fibroblasts Cosmetic or dermatological composition for topical treatment	EP1640041	Doering <i>et al.</i> , 2006
Treatment of skin, and wound repair, with thymosin beta 4	Compositions and methods for treatment of skin utilizing thymosin β 4.	US/2007/0015698	Kleinman <i>et al.</i> , 2007
Soluble isoflavone compositions	Isoflavone compositions exhibiting improved solubility (e.g., light transmittance), taste, colour, and texture characteristics, and methods for making the same	WO/2004/045541	Khare, 2004
An anti-oxidant preparation based on plant extracts for the treatment of circulation and adiposity problems	Preparation based on plant extracts which has an anti-oxidant effect and is particularly useful in treatment of circulation problems such as phlebitis, varicose vein, arteriosclerosis, haemorrhoid and high blood pressure.	EP1214084	Merizzi, 2002
Complexes of saponins with phospholipids and pharmaceutical and cosmetic compositions containing them	Complexes of saponins with natural or synthetic phospholipids have high lipophilic and improved bioavailability and are suitable for use as active principle in pharmaceutical, dermatologic and cosmetic compositions	EP0283713	Bombardelli <i>et al.</i> , 1987

Table 3. Commercial Products and Their Applications

S. No.	Trade name	Phytoconstituents complex	Daily dose	Indications
1	Silybin phytosome	Silybin from <i>Silibium marianum</i>	120 mg	Hepatoprotective, Antioxidant.
2	Silyphos milk thistle	Silybin from <i>Silibium marianum</i>	150 mg	Antioxidant, Hepatoprotective.
3	Grape seed(Leucoselect)phytosome	Procyanidins from <i>vitis vinifera</i>	50-300 mg	Antioxidant, Anticancer.
4	Ginseng phytosome	Ginsenosides from <i>panax ginseng</i>	150 mg	Immunomodulator
5	Hawthorn phytosome	Flavonoids from <i>crataegus species</i>	100 mg	Antihypertensive,Cardioprotective.
6	Sericoside phytosome	Sericoside from <i>Terminalia sericea</i>	–	Skin improver, Anti-Wrinkles
7	Ginko select phytosome	Flavonoids from <i>Ginkobiloba</i>	120 mg	Anti aging,Protects Brain & Vascular liling
8	Olea select phytosome	Polyphenols from <i>Oleauropea</i>	120 mg	Anti-hyperlipidemic, Anti-inflammatory
9	Green select phytosome	Epigallocatechin from <i>Thea sinensis</i>	50-300mg	Anti-cancer, Antioxidant
10	Echinacea phytosome	Echinacosides from <i>Echinacea angustifolia</i>	–	Immunomodulatory,Nutraceuticals.
11	Bilberry(Mertoselect) phytosome	Anthocyanosides from <i>Vaccinium myritillus</i>	–	Antioxidant, Improvement of Capillary Tone.
12	Palmetto (sabalselect) phytosome	Fattyacids,alcohols&sterols from <i>Serenoarepens</i>	–	Anti-oxidant, Benign Prostatic hyperplasia.
13	Visnadine(visnadax) phytosome	Visnadine from <i>Ammi visnaga</i>	–	Circulation Improver, Vasokinetic
14	Centellaphytosome	Terpens from <i>Centella asitica</i>	–	Brain tonic, Vein and Skin Disorder
15	Glycyrrhiza phytosome	18-β glycyrrhetic acid from <i>Glycyrrhiza glabra</i>	–	Anti-inflammatory ,Soothing
16	Melilotus(Lymphaselect) phytosome	Triterpens from <i>Melilotus officinalis</i>	–	Hypotensive,Indicated in Insomnia
17	Curcumin(merivaselect) phytosomes	Polyphenol from <i>Curcuma longa</i>	200-300 mg	Cancer Chemo preventive Agent
18	Mertoselectphytosome	Polyphenols, Antcinoside from <i>Vaccinium myrtilus</i>	–	Antioxidant
19	PA ₂ phytosome	Proanthocyanidin A ₂ from horse <i>Chestnut bark</i>	–	Anti-Wrinkles, UV protectant.
20	Escin β sitosterol phytosome	Escin β-sitosterol from horse <i>Chestnut fruit</i>	–	Anti-Odema.
21	Ximilene and ximen oil phytosome	Ximilene and ximen oil from <i>Santalum album</i>	–	Skin Smoother, Micro Circulation Improver
22	Ruscogenin phytosome	Steroid saponins from <i>Ruscusaculeatus</i>	–	Anti-inflammatory, Improve Skin circulation
23	Zanthalene phytosome	Zanthalene from <i>Zanthoxylumbungeanum</i>	–	Soothing, Anti-Irritant, Anti-Itching
24	Curbilene phytosome	Curbilene from <i>Curcubitapeposeeds</i>	–	Skin care, Matting Agent
25	Esculoside phytosome	Esculoside from <i>Aesculushippocastannum</i>	–	Vasoactiv, Anti-cellulite, Microcirculation improver

Figure 1. Arrangement of the herbosomal molecular complex. A flavonoid molecule (lower right) is enveloped by a phospholipid molecule

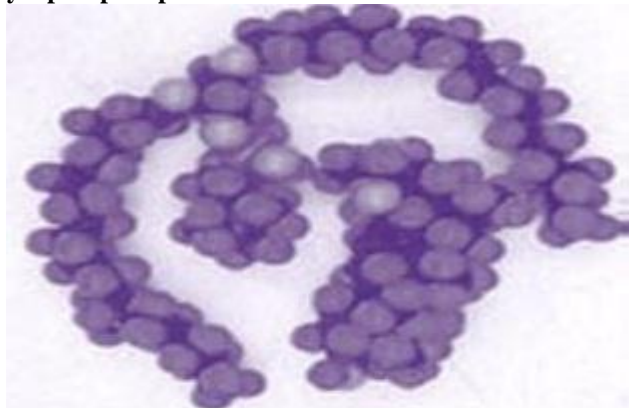
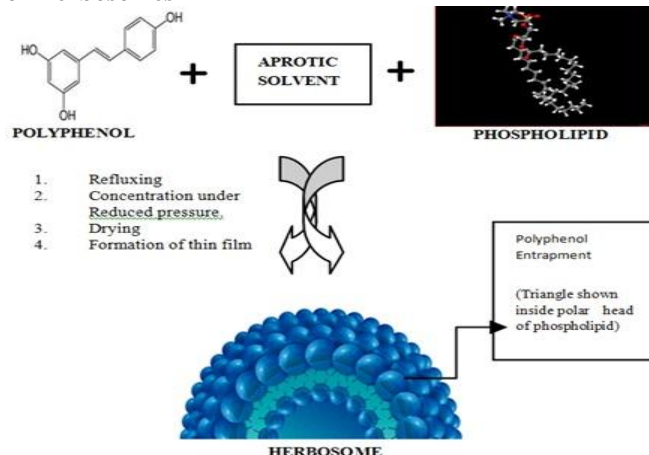


Figure 2. General Diagrammatic Representation of Herbosome Preparation Characterization and Evaluation of Herbosomes



CONCLUSION

Herbosomes results from the reaction of stoichiometric amount of phospholipid with standardized herbal extract or polyphenolic constituents like (flavonoids, terpenoids, tannins, xanthenes etc) in nonpolar solvents. This recent technology of drug delivery aids to explore maximum therapeutic potential of plant constituents of polar nature exhibiting remarkable therapeutic efficacy. Herbosomes shows much better

absorption profile following oral administration owing to improve lipid solubility which enables them to cross the biological membrane resulting enhanced bioavailability. Herbosomes have also improved pharmacokinetic and pharmacological parameters which advantageously be used in treatment of various disease as the more amount of active constituent becomes available at site of action at similar or less dose as compared to the conventional herbal extracts.

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