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A Critical Review on Applications of New Drug Delivery System

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ABSTRACT: ***Great strides have been made in the development of novel drug delivery systems (NDDS) for plant actives and extracts over the past few years. Bioactive and plant extracts have been used to record the range of novel herbal formulations such as polymeric nanoparticles, nano capsules, liposomes, phytosomes, nano emulsions, microsphere, transferosomes, and ethosomes. The novel formulations are reported to have remarkable advantages over traditional formulations of plant actives and extracts, including solubility enhancement, bioavailability, toxicity safety, pharmacological activity enhancement, and stability enhancement, improved distribution of tissue macrophages, sustained delivery, and physical and chemical degradation protection. The present review highlights the current status of the development of novel herbal formulations and summarizes their method of preparation, type of active ingredients, size, and entrapment efficiency, route of administration, biological activity and applications of novel formulations.***

KEYWORDS: ***Drug, Liposomes, Plant, Particles, Systems.***

INTRODUCTION

The liposomes are spherical particles in which a portion of the solvent is encapsulated and freely diffused (floated) into their interior. They can have one, two or multiple concentric membranes. Liposomes are composed of polar lipids characterised by the same molecules having a lipophilic and hydrophilic group. Polar lipids self-assemble and form self-organized colloidal particles upon contact with water[1]. Detergents, components form micelles, are simple examples, whereas polar lipids with bulkier hydrophobic components cannot interact with high curvature radii micelles but form bilayers that can self-close to liposomes or lipid vesicles. A liposome cross-section (Fig. 1) shows the amphiphile hydrophilic heads oriented towards the water compartment, while the lipophilic tails are oriented towards the middle of the vesicle away from the water, thereby forming a bilayer[2].

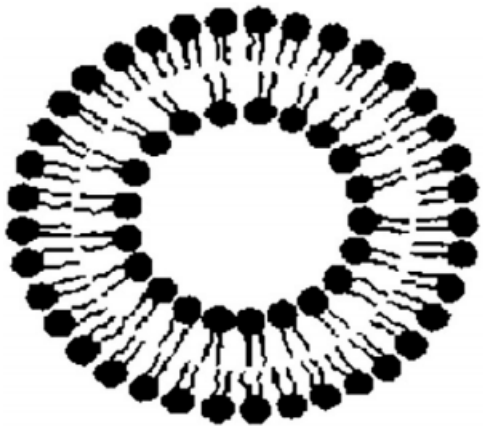

Figure 1: Illustrates the Cross-section of a liposome[3]**.**

Table 1: Illustrates the Liposomal herbal formulation[4].

Formulations	Active ingredients	Applications of liposome formulations	Biological activity	Method of preparation	% Entrapment efficiency	Route of administration
Quercetin liposomes	Quercetin	Reduced dose, enhance penetration in blood brain barrier	Antioxidant Anticancer	Reverse evaporation technique	60%	Intranasal
Liposomes encapsulated silymarin	Silymarin	Improve bioavailability	Hepatoprotective	Reverse evaporation technique	69.22 ± 0.6%	Buccal
Liposoma artemisia arborescens	Artemisia arborescens essential oil	Targeting of essential oils to cells, enhance penetration into, cytoplasmatic barrier	Antiviral	Film method and sonication	60–74%	In vitro
Ampelopsin liposome	Ampelopsin	Increase efficiency	Anticancer	Film-ultrasound method	62.30%	In vitro
Paclitaxel liposome	Paclitaxel	High entrapment efficiency and PH sensitive	Anticancer	Thin film hydration method	94%	In vitro
Curcumin liposome	Curcumin	Long-circulating with high entrapment efficiency	Anticancer	Ethanol injection method	88.27 ± 2.16%	In vitro
Garlicin liposome	Garlicin	Increase efficiency	Lungs	Reverse-phase evaporation method	90.77 %	–
Flavonoids liposomes	Quercetin and rutin	Binding of flavonoids with Hb is enhanced	Hemoglobin	Solvent evaporation	–	In vitro
Usnea acid liposome with β-CD	Usnea acid	Incrase solubility and localization with prolonged-release profile	Antimycobacterial	Hydration of a thin lipid film method with sonication	99.5%	In vitro
Wogonin liposome	Wogonin	Sustained release effect	Anticancer	Film dispersion method	81.20 ± 4.20%	In vivo
Colchicine Liposome	Colchicine	Enhance skin accumulation, prolong drug release and improve site specificity	Antigout	Rotary evaporation sonication method	66.3 ± 2.2%	Topical
Catechins liposomes	Catechins	Increased permeation through skin	Antioxidant and chemopreventive	Rotary evaporation	93.0 ± 0.1	Transdermal

Figure 2: Illustrates the (a) nano emulsion and (b) biopolymeric nanoparticle[5].

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DISCUSSION

Table 2: Illustrates the Phytosomal herbal formulations.

Formulations	Active ingredients	Applications of phytosomal formulations	Biological activity	Method of preparation	Dose	Route of administration
Ginkgo biloba phytosomes	Flavonoids	Flavonoids of GBP stabilize the ROS	Cardio-protective, antioxidant activity	Phospholipids complexation	100 mg and 200 mg/kg	Subcutaneous
Ginkgoselect phytosome	Flavonoids	Inhibits lipid peroxidation (LPO), stabilize the ROS	Hepatoprotective, antioxidant	Phospholipids complexation	25 and 50 mg/kg	Oral
Silybin phytosome	Flavonoids	Absorption of silybin phytosome from silybin is approximately seven times greater	Hepatoprotective, antioxidant for liver and skin	Silybin-phospholipid complexation	120 mg	Oral
Ginseng phytosome	Ginsenosides	Increase absorption	Nutraceutical, immunomodulator	Phospholipids complexation	150 mg	Oral
Green tea phytosome	Epigallocatechin	Increase absorption	Nutraceutical, systemic antioxidant, anti-cancer	Phospholipids complexation	50–100 mg	Oral
Grape seed phytosome	Procyanidins	The blood TRAP nTotal Radical-trapping Antioxidant Parameter) were significantly elevated over the control	Systemic antioxidant, cardio-protective	Phospholipids complexation	50–100 mg	Oral
Hawthorn Phytosome	Flavonoids	Increase therapeutic efficacy and absorption	Cardio-protective and antihypertensive	Phospholipids Complexation	100 mg	Oral
Quercetin phytosome	Quercetin	Exerted better therapeutic efficacy	Antioxidant, anticancer	Quercetin–phospholipid complexation	–	Oral
Curcumin phytosomes	Curcumin	Increase antioxidant activity and Increase bioavailability	Antioxidant, anticancer	Curcumin–phospholipid complexation	360 mg/kg	Oral
Naringenin phytosomes	Naringenin	Prolonged duration of action	Antioxidant activity	Naringenin–phospholipid complex	100 mg/kg	Oral

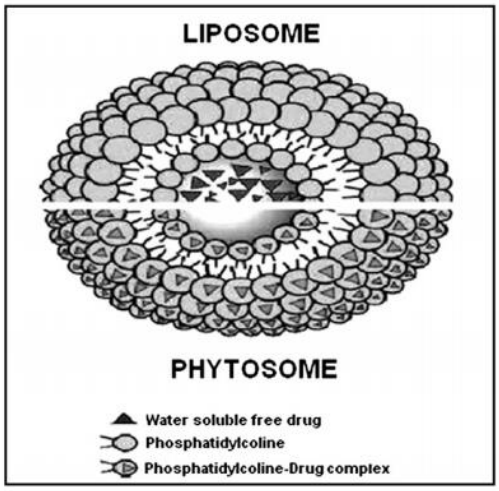

Figure 3: Depicts the difference between liposome and phytosome[6]**.**

ROS has a role in the initiation, growth and maintenance of cancer cells' phonotypical characteristics in cancer. Compared to their normal counterparts, increased ROS generation in tumour cells is due to the involvement of oncogenes that are also involved in malignant transformation[7]. The relationship between the increase in levels of ROS and oncogene activation is still unclear. Inflammation plays an etiological role in cases of some malignancies, such as lung and oral carcinomas. However, the stress induces ROS generation that cause chronic inflammation. Another most commonly implicated mechanism is oxidative DNA damage. ROS can activate various signaling pathways related to persistent tumour survival, metastasis, vascularization and proliferation in cancer cells, in addition to oxidative DNA damage, which can promote cancer growth[8]. Table 1 illustrates the Liposomal herbal formulation. Figure 2 illustrates the (a) nano emulsion and (b) biopolymeric nanoparticle. Table 2 illustrates the Phytosomal herbal formulations. Figure 3 depicts the difference between liposome and phytosome.

CONCLUSION

In the field of novel drug delivery and targeting plant actives and extracts, comprehensive research is underway. Research is, however, still at the exploratory stage in this region. Many research, development and application problems need to be solved. Moreover, in order to create more suitable carriers that can reduce the toxicity of drugs, increase their activity and boost the overall efficiency of agents, more attention should be paid to research on carrier materials. Herbal products have tremendous therapeutic potential that should be explored by certain systems of delivery of drugs with added value. The significant limiting factors for drug molecules to pass through the biological membrane to be systematically absorbed after oral or topical administration are lipid solubility and molecular size. Despite having excellent in vitro bio-activity, many plant extracts and phytomolecules show less or no in vivo activities due to their low lipid solubility or improper molecular size or both, resulting in poor absorption and poor bioavailability.

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