

Novel Herbal Drug Delivery Systems

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ABSTRACT

Novel drug delivery system is a novel approach toward drug delivery system that addresses the limitations of the traditional drug delivery systems. Our country has immense knowledge of Ayurveda whose potential is only being realized in the recent years. However, the drug delivery systems used for administering the herbal medicine to the patient is traditional and out dated, resulting in reduced efficacy of the drug. If the novel drug delivery technology is applied in herbal medicine, it may help in increasing the efficacy and reducing the side effects of various herbal medicines. Therefore it is important to incorporate novel drug delivery system to combat more serious diseases. For a long time herbal medicines were not considered for development as novel formulations due to lack of scientific rationalization and processing difficulties, such as standardization, extraction and identification of individual drug components in complex polyherbal systems. Many novel carriers such as nanoparticles, phytosomes, liposomes, microemulsion, etc. have been reported for successful modified delivery of various herbal drugs. This article summarizes various drug delivery technologies, which can be used for herbal active constituents.

Key words: Novel drug delivery system, herbal medicines, herbs, phytopharmaceuticals.

I. INTRODUCTION

The worldwide utilization of herbal drugs has increased due to their vast therapeutic effects and less side effects as compared to the allopathic medicines. Herbal drugs are made from plants and their extractives. Herbal formulation refers to a dosage form containing one or more herbs in specific quantities to provide definite nutritional, cosmetic and other health benefits. With advancements in improvements with analysis and quality control of herbal medicine, it has been emerged as safe treatment option. [1]

The method by which a drug is delivered can have a significant effect on its efficacy. Some drugs have an optimum concentration range within which maximum benefit is derived, and concentrations above or below this range can be toxic or produce no therapeutic benefit at all. On the other hand, the very slow progress in the efficacy of the treatment of severe diseases has suggested a growing need for a multidisciplinary approach to the delivery of therapeutics to targets in tissues. From this, new ideas on controlling the pharmacokinetics, pharmacodynamics, non-specific toxicity, immunogenicity, biorecognition and efficacy of drugs were generated. These new strategies, often called drug delivery systems (DDS), are based on interdisciplinary approaches that combine polymer science, pharmaceuticals, bioconjugate chemistry and molecular biology. [2]

In the past few decades, considerable attention has been concentrated on the evolution of a novel drug delivery system (NDDS) for herbal drugs. Conventional dosage forms, including prolonged-release dosage forms, are unable to satisfy for both holding the drug component at a distinct rate as per directed by the requirements of the body, all through the period of treatment, as well as directing the phytoconstituents to their desired target site to obtain an utmost therapeutic response. In phytoformulation research, developing nano-sized dosage forms such as polymeric nanoparticles, liposomes, solid lipid nanoparticles, phytosomes, and nanoemulsion has a number of advantages for herbal drug e.g. enhancement of solubility and bioavailability, protection from toxicity, enhancement of pharmacological activity, enhancement of stability, sustained delivery, and protection from physical and chemical degradation. Thus, the nano-sized NDDSs of herbal drugs have a potential future for enhancing the activity and overcoming problems associated with the plant medicines. [3]

Incorporation of novel drug delivery technology to herbal or plant actives minimizes the

drug degradation or presystemic metabolism and serious side effects by accumulation of drugs to the nontargeted areas and improves the ease of administration in the pediatric and geriatric patients. [4]

II. ADVANTAGES OF HERBAL DRUGS

Herbal drugs possess following advantages [5-7].

- a. Low risk of side effects Mostly herbal drugs are well tolerated by the patient, having fewer unintended consequences and fewer side effects than traditional medicine, and may be safer to use.
- b. Effectiveness Herbal drugs are more effective for long-standing health complaints that don't respond well to traditional medicine. One example is the herbs and alternative remedies used to treat arthritis. Vioxx, a well-known prescription drug used to treat arthritis, was recalled due to increased risk of cardiovascular complications. Herbal treatments for arthritis, on the other hand, have lesser side effects. Such treatments include dietary changes like adding simple herbs, eliminating vegetables from the nightshade family and reducing white sugar consumption.
- c. Lower cost Cost of herbal drugs is much less than prescription medications. Research, testing, and marketing add considerably to the cost of prescription medicines. Herbs tend to be inexpensive compared to drugs.

III. LIMITATIONS OF HERBAL DRUGS

Herbal drugs possess following limitations [8-13].

- a) Not suitable for many diseases
Modern medicine treats sudden and serious illnesses and accidents much more effectively than herbal or alternative treatments. An herbalist would not be able to treat serious trauma, such as a broken leg, nor would he be able to heal appendicitis or a heart attack as effectively as a conventional doctor using modern diagnostic tests, surgery, and drugs.
- b) Lack of dosage instructions
Self-treatment with herbal drugs may consist of many risk factors. Moreover, with no proper direction of doses may lead to overdose.
- c) Poison risk associated with wild herbs
Consumption of herbal drugs without correct identification of plant i.e., use of wrong part of plant may lead to poisoning.
- d) Lack of regulation
Herbal products are not strictly regulated, consumers may buy inferior quality herbs. The quality of herbal products may vary among

batches, brands or manufacturers. This can make it much more difficult to prescribe the proper dose of an herb. All herbal drugs are not safe; some may be poisonous or may cause allergenic reactions.

- e) Longer duration of treatment
Curing period is usually longer in comparison to conventional medication. Immense patience while undergoing herbal treatment is needed.

IV. TYPES OF NOVEL HERBAL DRUG DELIVERY SYSTEMS

Novel approach of delivering herbal drugs will increase the efficacy, effectiveness, efficiency and safety of herbal medicines along with the increased stability of the bioactive agents. These techniques provide improved patient compliance, sustained release and targeted action of plant actives and extracts. Recent advances in nanotechnology shows greater prospective for medicaments that are poorly soluble, poorly absorbed and has unstable herbal extracts or photochemical. In this respect, various approaches are studied such as liposomes, phytosomes, Ethosomes, dendrimers, transfersomes, etc. are discussed below(Fig.1)

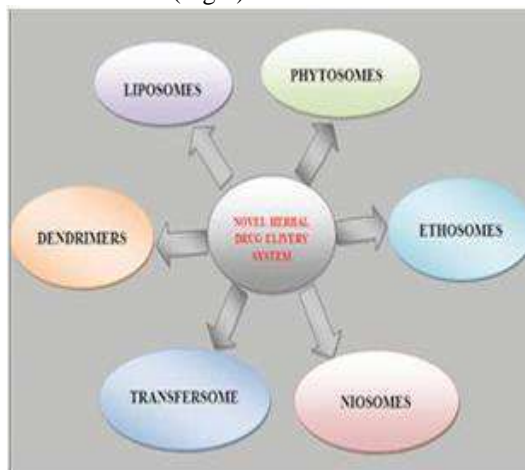


Figure 1 Novel drug delivery systems of herbal drugs [14]

1. LIPOSOMES:

Liposomes are the biodegradable, colloidal and spherical vesicles (0.05-5.0 µm in diameter) composed of a bilayer membrane entrapping an aqueous core. Liposome membranes can be composed of naturally-derived phospholipids with mixed lipid chains and a variation of head groups or of pure synthetic lipids with defined acyl chains and head groups. Drugs with widely varying lipophilicities can be encapsulated in the liposomes, either in the

phospholipids bilayer, in the entrapped aqueous volume or at bilayer interface. Liposomes usually formed from phospholipids have been used to change the pharmacokinetic profile of not only drugs, but herbs, enzymes etc. Liposomal based drug delivery is advantageous specifically it enhancing the therapeutic index of anti-cancer agents, either by increasing the drug concentration in the tumour cells and by decreasing the exposure to normal cells. Various targeting strategies can be exploited using liposomal drug delivery system. There are lots of herbal liposomal formulations have been reported for herbal drugs where liposome are able to enhance product performance by solubility enhancement, improving bioavailability, targeting at site of action and prolonged release of drug.(Fig.2)

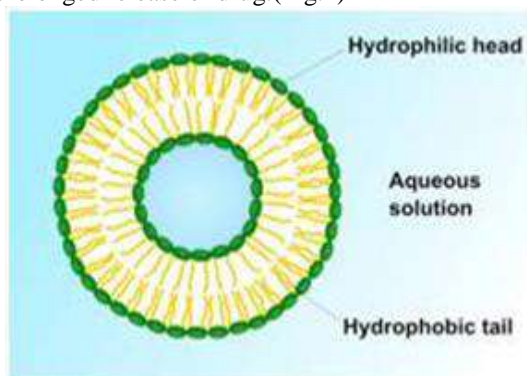


Figure 2 Structure of liposomes [15]

2. PHYTOSOME:

The term “phyto” means plant while “some” means cell-like.¹⁰ Phytosomes are little cell like structure. This is advanced forms of herbal formulations which contains the bioactive phytoconstituents of herb extract surrounds and bound by a lipid. Most of the bioactive constituents of phytomedicines are water-soluble compounds like flavonoids,¹¹ terpenoids glycosides out of these flavonoids are a major class of bioactive compounds possesses broad therapeutic activities.¹² Because of water soluble herbal extract and lipophilic outer layer phytosomes shows better absorption which result better bioavailability and actions than the conventional herbal extracts containing dosage form.(16-19)

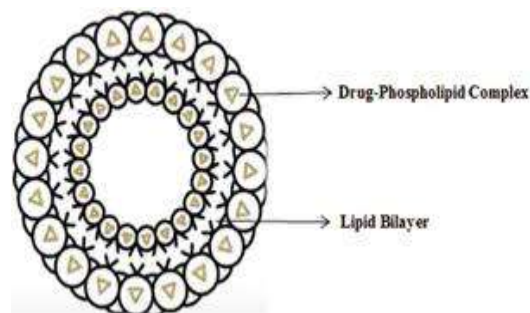


Figure 3 Structure of phytosomes [20]

ADVANTAGES OF PHYTOSOMES (21-23)

Phytosomes have the following advantages

- As the absorption of active constituents is improved, its dose requirement is also reduced.
- It enhances the absorption of lipid insoluble polar phytoconstituents through oral as well as topical route showing better bioavailability, hence significantly greater therapeutic benefit.
- Chemical bonds are formed between phosphatidylcholine molecule and phytoconstituent, so the phytosomes show better stability profile.
- Added nutritional benefit of phospholipids.
- Phosphatidylcholine used in preparation of phytosomes, besides acting as a carrier also acts as a hepatoprotective, hence giving the synergistic effect when hepatoprotective substances are employed.
- It enhances the absorption of herbal constituent and hence the bioavailability.
- It gives nutritional benefit of phospholipid.

3. Ethosomes

Newer advancements in the patch technology have lead to the development of ethosomal patch, which consists of drug in ethosomes. Ethosomal systems are made up of soya phosphatidylcholine, ethanol and water. They may form multilamellar vesicles and have a high entrapment capacity for molecules of various lipophilicities. The elastic vesicles and transfersomes have also been used as drug carriers for a range of small molecules, peptides, proteins and vaccines. [24]

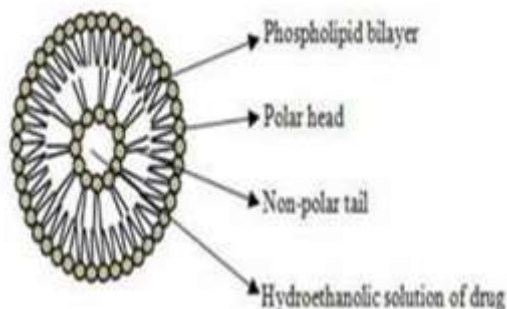


Figure 4 Structure of ethosomes[25]

4. Niosomes

Niosomes are multilamellar vesicles formed from nonionic surfactants of the alkyl or dialkylpolyglycerol ether class and cholesterol. Earlier studies in association with L'Oreal have shown that, in general, niosomes have properties as potential drug carriers similar to liposomes.[26] Niosomes are different from liposomes in that they offer certain advantages over liposomes. Liposomes face problems such as they are expensive, their ingredients such as phospholipids are chemically unstable because of their predisposition to oxidative degradation, they require special memory and handling, and purity of natural phospholipids is variable. Niosomes do not have any of these problems.[27]

5. Transferosomes

Transferosomes are sac-like vesicle composed of phospholipids that acts as potential carriers for the delivery of the drug through transdermal route. It overcomes the penetration difficulty through the stratum corneum. Due to their flexibility, it can easily penetrate through the intracellular pores of the skin. Colchicine delivery through transferosomes provides sustained, local and site-specific delivery and preventing it from the gastrointestinal side effects due to oral administration [28] (Figure 3).

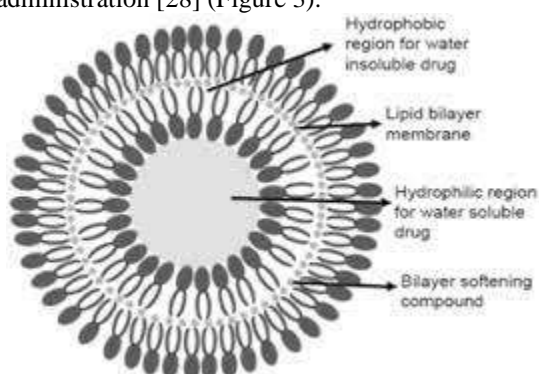


Figure 3: Structure of transferosomes.

CONCLUSION:

A number of plant constituents like flavanoids, tannins, terpenoids etc. showed enhanced therapeutic effect at similar or less dose when incorporated into novel drug delivery vehicles as compared to conventional plant extracts. Hence there is great potential in development of novel drug delivery system for valuable herbal drugs as it provides efficient and economical drug delivery and the trends of incorporating Recent technologies of drug delivery when applied to botanicals open new avenues to explore maximum therapeutic potential of plant substances of polar nature. Herbal drugs have plenty of therapeutic potential. Therefore applications of novel drug delivery systems to phytoconstituents can lead to enhanced bioavailability, increased solubility and permeability, thereby reducing the dose and hence, side effects.

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