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# Overview on Novel Drug Delivery System

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**ABSTRACT:** Plants are nature's remedies and have been used by human and animals on earth since ancient times for food and medicine. Today there are global movements towards finding of herbal drugs in plants to bring them in market via a novel drug delivery system for mankind. The basic thought behind it is used for the treatment of each disease is hidden in nature. The delivery of herbal drugs also requires some modification with the purpose to achieve sustain release/controlled release, to increase the duration of action and patient compliance etc. In earlier times, the herbal drugs could not attract scientists towards the modifications of novel drug delivery systems due to processing, standardizing, extracting and identification difficulties. But now days with the improvement in the technology, new drug delivery systems used in the development of herbal novel drug delivery system. With the use of advanced techniques protection from toxicity, enhancement in stability, improved bioavailability and increased duration of action of herbal formulations, protection from physical and chemical degradation can be achieve. Novel drug delivery technologies have gained the importance to achieve modified delivery of herbal drugs their by increasing the therapeutic efficacy and also reducing toxicity. The present reviews gives more information regarding various novel techniques used for improving safety and efficacy of herbal medicines and application of novel drug delivery system.

**KEY WORDS:** New drug delivery system, Ethosomes, Pharmacosomes Niosomes, Nanoparticles, Microsphere, Nano suspension, Nano emulsion.

## I. INTRODUCTION:

Herbal drug delivery system means a dosage form contains one or more herbs or processed herbs in specified quantities to provide specific nutritional, cosmetic benefits, and/or other benefits. Herbal preparations are obtained by subjecting the whole plant or fragmented or cut plants, plants parts to treatments such as distillation, extraction, expression, fractionation, purification, concentration or fermentation. This includes comminuted or powdered herbal substances, tinctures, extracts, essential oils, expressed juices and processed exudates [1]. Herbal drugs are the complex structure of many active constituents; As all of them provide synergistic action and enhance the therapeutic value [2]. Herbal drugs have lesser side effects [3,4].

Herbal drugs have some advantages than traditional medicines such as lower risk of side effects, widespread availability, low cost and efficacious for lifestyle diseases for prolonged period of time [5]. Incorporating herbal drugs into novel drug delivery systems not only used to reduce the repeated administration to overcome noncompliance, but also help to increase the therapeutic efficacy by reducing toxicity and increasing the bioavailability and duration of action. 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 compounds and herbs [6]. Novel drug delivery system is one of the new approaches to drug delivery in to the body. It helps the drug to act longer duration of action and more effectively; control of the distribution of drug is achieved by incorporating the drug in carrier system or in changing the structure of the drug at molecular level etc.

**Advantages of novel drug delivery system**

1. Protection from physical and chemical degradation.
2. Sustained delivery/controlled drug delivery.
3. Increased tissue macrophages distribution.
4. Enhancement of stability.
5. Enhancement of pharmacological activity.
6. Protection from toxicity.
7. Enhanced bioavailability.
8. Enhancement of solubility [7].

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**Recent developments in novel drug delivery system of herbal drugs**

1. Phytosome
2. Liposome
3. Nanoparticles
4. Emulsions
5. Microsphere
6. Ethosome
7. Solid lipid nanoparticle
8. Niosomes
9. Proniosomes
10. Transdermal Drug Delivery System
11. Dendrimers
12. Liquid Crystals
13. Hydrogels [8]

**Phytosome**

Phytosome is lipid compatible molecular complex which are composed of "phyto" which means plant and "some" meaning cell-like [9]. Complexing the polyphenolic phytoconstituents in the molar ratio with phosphatidyl choline results in a novel herbal drug delivery system, known as "Phytosome". Phytosomes are advanced forms of herbal products that are better absorbed, utilized to produce better results than those produced by conventional herbal extracts. Phytosomes show better pharmacokinetic and therapeutic profiles than conventional herbal extracts [10].

**Advantages of phytosome**

1. Phytosome is used to increases the absorption of active constituents, so its dose size required is small.
2. There is appreciable drug entrapment and enhancement in the solubility of bile to herbal drugs, and it can target the liver.
3. In Phytosome, chemical bonds are formed between phosphatidylcholine molecules, so it gives good stability [11].
4. Phytosome improves the percutaneous absorption ofherbal phytoconstituents [12].

**Liposome**

Liposomes are concentric bi-layered vesicles in which aqueous volume is entirely enclosed by a membranous lipid bi-layer mainly composed of natural or synthetic phospholipids. The liposome is spherical particles that encapsulate the solvents which are freely floating in the interior [13].

**Advantages of liposomes**

1. Improvement biocompatibility.
2. Preparation of liposome is easy.
3. The chemical versatility that allows incorporating hydrophilic, amphiphilic, and lipophilic compounds.
4. The simple modification of their pharmacokinetic parameters by changing the chemical composition of the bilayer components [14].

**Nanoparticles**

Nanotechnology is one of the sciences of matter and material that deal with the particle size in nanometers. The word "Nano" is derived from Latin word, which means dwarf (1nm=10-9m). Nanoparticles are defined as particulate dispersions or solid particles with a size in the range of 10-1000nm. The drug is dissolved, entrapped, encapsulated or attached to a nanoparticle matrix (polymer matrix) [15]. Nanoparticles offer some specific advantages such as they help to enhance the stability of drugs/proteins and possess useful controlled release/sustained release properties. It can be changed or modified to achieve both active and passive targeting; drug loading is very high and can be administered by various routes such as parenteral, nasal, intra ocular and oral routes [16].

**Advantages of herbal nanoparticle delivery system**

1. Nanoparticulate system delivers the herbal drug formulationdirectly to the site of action.
2. Enhanced efficacy and therapeutic index.
3. Enhanced stability via encapsulation.
4. Improved pharmacokinetic effect.
5. Producible with various sizes, compound surfaceproperties [14].

**Emulsions**

Emulsion is a biphasic system in which one phase is intimately dispersed in the other phase in the form of minute droplets in ranging in diameter from 0.1µm to 100 µm. In emulsion, one phase is always water or aqueous phase, and the other phase is oily liquid, i.e. non aqueous. Among them, the microemulsion is also called nanoemulsion, and the sub-micro-emulsion is called liquid emulsion [17]. Microemulsion is a clear, thermodyanamically stable, frequently in combination with a co-surfactant [18].

**Advantages of emulsion-based formulations**

1. It can release the drug for a long period of time because it is packed in the inner phase and makes direct.
2. Nano emulsion is contact with the body and

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other tissues.

3. As a result of the lipophilic drugs being made into o/w/o emulsion, the droplets of oil are phagocytosised by macrophages and enhance its concentration in liver, spleen and kidney.
4. As the emulsion contains herbal drug formulation, it will enhance the stability of hydrolyzed formulated material and increase the penetrability of drug into skin and mucous.
5. The new type, viz., Elemenum emulsion, is used as an anti-cancer drug and it does not produce harmful effect to the heart and liver [19].

**Microsphere**

Microspheres comprise of small spherical particles, with micrometer in diameters, typically 1 μm to 1000 μm (1 mm). Microspheres are sometimes called to as micro-particles. Microspheres can be manufactured from different various natural and synthetic materials. Different types of microsphers such as Glass microspheres, polymer microspheres and ceramic microspheres are commercially available. Microspheres are classified as biodegradable or non-biodegradable. Biodegradable microspheres include albumin microspheres, modified starch microspheres, gelatin microspheres, polypropylene dextran microspheres, polylactic acid microspheres, etc. According to the current literature reports on non-biodegradable microspheres, polylactic acid is the only polymer approved to be used by people, and it is used as a controlled-release/sustained release agent. Solid and hollow microspheres vary widely in density and therefore are used for different applications [20].

**Advantage of microsphere formulation**

1. Administration of herbal drugs via micro-particulate system is advantageous because microspheres can be ingested or injected, and they can be tailored for desired release profiles and used for site-specific drug delivery and in some cases can even provide organ targeted release mechanism.
2. Drug can be easily discharged from the formulation.
3. It is used to protect the specific function of drugs, and can release the drugs into an outer phase for a prolonged period of time.

**Ethosomes**

Ethosomes are developed by mixture of phospholipids and high concentration of ethanol. This one of the carrier can easily penetrate through the skin deeply lead to improve the drug delivery into deeper layer of skin and in systemic circulation. This formulation is useful for topical delivery of alkaloids in form of gels and creams for patients comfort. They show enhance in their permeability through the skin by fluidizing the lipid domain of the skin. Unstable nature and poor skin penetration are limits for Ethanosomes topical delivery. The Ethosomes were developed and examined for their ability in topical absorption of Tetrandine through dermal delivery and the relation of formulations to the pharmacological activity of Tetrandrine loaded in the formulation was also accessed. The tetrandine drug levels in rat plasma results showed that when Tetrandrine loaded Ethosomes were topically administered in rats; the drug level was less to be detected in rat plasma. By providing fewer delivery of Tetrandrine into bloodstream, topical administration might offer good efficacy with minimized side effects, thus leading to better patient's compliances. In conclusion, Ethosome was demonstrated to be promising carrier for increasing topical delivery of Tentrandrine via skin [21].

**Advantages of ethosomal drug delivery**

1. Ethosomes are used to enhance transdermal permeation of drug through skin.
2. Ethosomes are a platform for the delivery of largeamounts of various groups of drugs.
3. Ethosomal drug is administered in semisolid dosage form resulting in better patient compliance [22].

**Solid Lipid Nanoparticles (SLN)**

It is one of the technique was developed in the 1990's. Solid Lipid Nanoparticle is a colloidal carrier used especially for the delivery of lipophilic drugs. The solid lipid nanoparticles size ranges from 50 nm to 1000 nm. Solid lipid nanoparticle is composed of lipid matrix, which becomes solid at room temperature and also at the body temperature [23]. The main features of solid lipid nanoparticle (SLNs) with regard to parenteral application is used to give a excellent physical stability, protection of incorporated sensitive drugs from degradation. To cross blood brain barrier, it should be made for selection of lipids and surfactants. The Solid Lipid Nanoparticles are prepared by different methods such as homogenization, warm micro-emulsion high-speed stirring ultra sonication and solvent-diffusion method. A lipid shows compatibility with lipophilic drugs with high entrapment efficiency and drug-loading into the SLN [24].

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**Advantages of SLN herbal formulation**

1. Solid Lipid Nanoparticles are used to provide controlled release and site-specific drug targeting.
2. Large-scale production of solid lipid nanoparticles is possible.
3. In this formulation, both lipophilic and hydrophilic drugs can be incorporated.
4. Other advantage is that it is used to made lipid matrix (physiological lipids), which reduce danger of chronic and acute toxicity.

**Niosomes**

Niosomes are multilamellar vesicles formed with the use of non-ionic surfactants of the alkyl or dialkyl polyglycerol 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. Niosomes are differentiated from liposomes in that they have some advantages over liposomes [25].

**Proniosomes**

Proniosomes gel system is step forward to niosome, it can be utilized for various applications in delivery of actives at desire site. Proniosomal gel is the formulation, which on in situ hydration with water from the skin and it is converted into niosomes [17].

**Advantages of Proniosomes**

1. It should be stable during storage and sterilization
2. Transportation is very easy.

**Transdermal Drug Delivery System**

Nowadays Transdermal drug delivery system has been an enhanced interest in the drug administration through skin for both local therapeutic effects on diseased skin (topical delivery) as well as for systemic delivery of drugs. But immense potential lies in transdermal drug as future smart drug delivery devices [26]. These are the devices in which drug incorporated in the formulation permeates into the systemic circulation by diffusion process to stratum corneum and further passed into the affected organ. The Transdermal Drug Delivery System formed with the use polymer matrix, adhesive bandage and permeation enhancers.

**Merits of Transdermal Drug Delivery System**

1. Controlled delivery of drugs.
2. Increased drug bioavailability.
3. Minimized side effects and easy of application.
4. Transdermal delivery of herbal drugs is to enhance the penetration and sustained/controlled action. e.g.Transdermal films containing boswellic acid ( Boswellia serrate) and curcumin (Curcuma longa) were formulated. This formulation used for the treatment of inflammation (synergistic effect).

Limitations are hepatic first pass metabolism, enhanced therapeutic effect, and maintenance of steady state concentration in the serum blood level [27].

**Dendrimers**

Dendrimers are nanometer-sized, highly branched and monodisperse macromolecules with symmetrical architecture while their stability and protection from the Mononuclear Phagocyte System (MPS) is being achieved by functionalization of the dendrimers with polyethylene glycol chains (PEG) [28].

**Liquid Crystals**

Liquid Crystals combine with the properties of both liquid and solid states. They can be made from different geometries, with alternative polar and non-polar layers (i.e., a lamellar phase) where aqueous drug solutions can beincluded [29].

**Hydrogels**

Hydrogels are three-dimensional, hydrophilic, polymeric networks capable of imbibing large amounts of water or biological fluids. They are used to regulate drug release in reservoir-based, controlled/sustanined release systems or as carriers in swellable and swelling-controlled release devices[30].

## II. CONCLUSION:

Novel drug delivery system not only minimizes the repeated administration to overcome patient non compliance, but also helps to enhance the therapeutic value by minimizing toxicity and enhancing the bioavailability, and so on. Extensive research is going for herbal drugs to incorporate them into novel drug delivery systems. Application of these novel techniques to natural medicines will led to increased bioavailability, minimized toxicity, sustained/controlled release action, protection from GI degradation.

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