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A REVIEW ON NOVEL DRUG DELIVERY SYSTEM: A RECENT TREND

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Abstract:

Plants are natural remedies and have been used as food and medicine by humans on earth since ancient times. Today there are efforts to find herbal medicines in plants in order to bring them to market through a drug delivery system suitable for humanity. The basics idea behind it is that the cure for every disease is hidden in nature. However, herbal drug delivery also requires modifications with the purpose to achieve sustained release, increase patient compliance, etc. So far, herbal medicines have failed to attract scientist's changes to new drug delivery systems due to difficulties in processing, standardization, extraction, and identification. But now days with the technological advances, new drug delivery systems (NDDS) open the door to the development of new herbal medicines system. Using advanced techniques to protect against toxicity, enhance stability, improve bioavailability of herbal formulations, protection against physical and chemical degradation can be achieved. New drug delivery technologies have gained prominence to achieve the modified release of herbal medicines to increases their therapeutic value and decreases their toxicity. Current ratings provide insight on various new techniques used to improve the safety and efficacy of phytomedicines and the application of new formulations. The most important goal for developing such delivery systems is to minimize drug degradation and loss, and to prevent and increase harmful side effects biological availability. Targeting is the ability to direct the drug-laden system to the location of interest. Among the drug carriers there are solubles polymers, micro particles consisting of insoluble (or) biodegradable natural and synthetic polymers, microcapsules, cells, ghost cells, lipoproteins, liposomes and micelles. Two main mechanisms can be distinguished for targeting the desired drug delivery sites, (a) passively and (b) Active targeting. Controlled drug delivery systems, such as micellar solutions, vesicles and liquid crystal dispersions, as well as nanoparticles Dispersions consisting of small particles of 10-400 nm are promising as drug delivery systems. Hydrogels are three-dimensional, hydrophilic polymer networks capable of absorbing large quantities of water or biological fluids.

Key words: *Novel drug delivery system, Phytosome, Nanoparticle, Microsphere, Transdermal drug delivery system carrier, Colloidal drug delivery system*

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INTRODUCTION:

The term herbal formulate means a dosage form consisting of one or more herbs or processed herbs in specified quantities to provide specific benefits. Herbal preparations are obtained by subjecting whole plant, fragmented or cut plants, plant parts to treatments such as distillation, extraction, expression, fractionation, purification, concentration or fermentation1.Herbal drug itself is a complex structure of many active constituents; as all of them provide synergistic action and enhance the therapeutic value2. Lower risk of side effects, widespread availability, low cost and efficacious for lifestyle diseases for prolonged period of time are the advantages of herbal drugs over traditional medicine3. Incorporating herbal medicines into the administration of new medicine systems not only reduce the repeated dosage to overcome the non-compliance, but also help increase the therapeutic value by reducing toxicity and increasing the biological availability. 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 herbs4. Novel drug delivery system is a novel perspective to drug delivery. It helps the drug to act longer 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.

Benefits of novel drug delivery system:

1. Protection against physical and chemical decomposition.
2. Sustained supply.
3. Better tissue macrophages distribution.
4. Better tissue macrophages distribution.
4. Improvement of stability.
5. Improvement of pharmacological activity.
6. Protection against toxicity.
7. Enhanced bioavailability.
8. Enhanced solubility5.

Recent advancements in novel drug delivery system of herbals:

1. Emulsion
2. Nanoparticles
3.Liposome
4. Phytosome
5. Microsphere
6. Ethosome
7. Solid lipid nanoparticles
8. Niosomes
9. Proniosomes
10.Hydrogels
11. Liquid crystals
12. Dendrimers

Phytosomes:

Phytosomes are lipid molecular complex which are composed of “phyto” meaning Plant and “some” meaning cell-like7. Complexation of polyphenolic phyto-ingredients in molar ratio with Phosphatidylcholine leads to new herbal drug delivery system known as the "phytosome". Phytosomes are advanced better absorbed forms of herbal products which are used get better results than traditional plant extracts. Phytosomes exhibit better pharmacokinetics and therapeutic profiles than traditional plant extracts8.

Liposome:

Concentric bi-layered vesicles are called as liposomes. They are completely surrounded by an aqueous volume. This bilayer membrane primarily made of natural or artificial phospholipids. The spherical liposomes encase the freely flowing liquids floating within interior9 .

Nanoparticles:

Nanoparticles (including Nano spheres and Nano capsules of size 10-200 nm) are solid state and are both amorphous and crystalline. They can adsorb and/or encapsulates a drug and thus protects it from chemicals and enzymatic degradation. Biodegradable polymeric nanoparticles in recent years have attracted many attention as potential drug delivery devices given their applications in controlled drug release, targeting some organs/tissues, such as DNA carriers in genes therapy and in their ability to synthesize proteins, peptides and oral genes.10,11

Emulsions:

The emulsion is a two-phase system in which one phase is intimately dispersed in the other phase in the form of the smallest droplets in the diameter range from 0.1 µm 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 micro emulsion is also called Nano emulsion, and the sub-micro-emulsion is called liquid emulsion12. Micro emulsion is a clear, thermodynamically stable, frequently in combination with a co-surfactant13.

Microspheres:

Small, spherical particles called microspheres typically range in size from 1 µm to 1000 µm and have

diameters in the micrometre range (1 mm). Microspheres are also known as micro-particles. Microscopic spheres are made from a variety of organic and synthetic materials. Microspheres made of glass, polymer, and ceramic can be bought commercially. The microspheres categorised as either biodegradable or not. Biodegradable microspheres include modified starch microspheres, albumin microspheres, gelatin microspheres, polylactic acid microspheres, polypropylene dextran microspheres etc. Currently available literature suggests polylactic acid, a non-biodegradable microsphere is the only polymer permitted for human usage, and it is a controlled-release agent14.

Ethosomes:
Ethosomes are grown by mixing phospholipids and high concentration of ethanol. This carrier can penetrate deep through the skin to improve drug delivery to the deeper layers of the skin and into the bloodstream. These formulations are useful for the topical administration of alkaloids in gel and cream form for patient comfort. They show Increase in their permeability through the skin by fluidization of the lipid domain of the skin. Unstable nature and bad skin Penetration are limits for the tropical delivery of ethaosomes. The ethosomes have been developed and studied for their ability for topical absorption of tetrandine via cutaneous administration, and also the relationship of the formulations to the pharmacological activity of the tetrandrin loaded into the formulation was approached. The result of drug levels in rat plasma demonstrated that when tetrandrin was loaded, ethosomes were topical administered to rats, the drug level was low to be detected in rat plasma concluded that ethosoms have been demonstrated to be a promising vector to improve topical delivery of Tentrandrin through the skin15.

Solid lipid nanoparticles:
(SLN) are a novel pharmaceutical delivery system or pharmaceutical formulation. Conventional approaches such as using permeation enhancers, surface modification, prodrug synthesis, complex formation and strategies based on colloidal lipid carriers are developed for the delivery of drugs to the intestine lymph vessels. Moreover, the same polymer nanoparticles emulsifier delivery systems, liposomes, microemulsions, micellar solutions and solid lipid nanoparticles recently (SLN) have been exploited as probable opportunities such as vectors for oral intestinal lymphatic delivery16.A solid lipid nanoparticle is typically spherical with an average diameter between 10 and 1000 nanometers. Solid Lipid nanoparticles have a solid lipid core matrix which can solubilize lipophilic molecules. Surfactants (emulsifiers) are used to stabilize lipid core. The term lipid is used here in a broad sense and includes steroids (eg cholesterol) triglycerides (eg. tristearin),mono-Glycerides (eg glycerol monostearate), fatty diglycerides (e.g. glycerol bahenate), fatty acids (eg stearic acid), and waxes (eg cetyl palmitate).All classes of emulsifiers were used for stabilization of lipid dispersion. It was found that the combination emulsifiers could further prevent particle agglomeration more efficiently.17,18

Niosomes:
Niosomes are multilamellar vesicles formed from non-ionic surfactants of the alkyl or dialkyl polyglycerol ether class and cholesterol. Studies from L'Oreal have shown that, in general, niosomes have drug carrier's property similar to liposomes. Niosomes are different from liposomes in that they offer certain advantages over liposomes19.

Proniosomes:
Proniosomes gel system is an improvement over nanoparticles and can be used for a variety of applications in the delivery of active ingredients. Proniosomal gels are the formulations that, when in situ hydrated with water from skin, become niosomes20.

Dendrimers:
Dendrimers are carefully characterised artificial nanoparticles with a diameter of roughly 5-10 nm. They are composed of polymer layers that enclose a control core. The surface of dendrimers has a variety of locations where medications can be attached, as well as places where materials like PEG can be attached in order to alter how the dendrimer interacts with the body. Dendrimer can have PEG bonded to it to disguise it and stop the body's defence mechanism from identifying it, which will slow the breakdown process. This intriguing particle has great potential for the treatment of cancer. Its numerous branches make it simple for other molecules to adhere to its surface. Researchers have fashioned dendrimers into sophisticated anticancer machines carrying five chemical tools-a molecule designed to bind to cancer cells, a second molecule that fluorescence upon locating genetic mutations, a third molecule to assist in imaging tumour shape using x-rays, a fourth molecule carrying drugs released on demand, and a fifth molecule that would send a signal when cancerous cells are finally dead.21

Liquid crystals:
Liquid crystals combine the properties of liquid and solid states. They can be manufactured to form different geometries, with alternative polar and non-polar layers (i.e. lamellar phase) in which aqueous drug solutions can be encapsulated.22

Hydrogels:
Hydrogels are three-dimensional, hydrophilic, polymeric networks which can encapsulate large amounts of water or biological fluids, they are used to regulate drug release in reservoir-based, controlled release systems or as carriers in swellable and swelling controlled release devices.23

Route of administration:
The choice of a delivery route is determined by the patient acceptability, the properties of the drug (such as its solubility), access to a site of disease or effectiveness in addressing the specific disease. The main drug delivery route is the oral route. A growing number of medicines are based on proteins and peptides. They offer the best potential for more effective therapies, but they don't easily pass through mucous surfaces and biological membranes; they are easily denatured or degraded, prone to fasting clearance in the liver and other body tissues and require accurate dosing. At this point, protein drugs are usually given by injection, but this route is less pleasant and it also poses problems of fluctuating drug concentrations in the blood. Despite existing barriers to successful drug delivery in the gastrointestinal tract (i.e. acid-induced hydrolysis in stomach, enzymatic degradation throughout gastrointestinal tract by several proteolytic enzymes, bacterial fermentation in the colon), the per oral route persists the most studied because of its benefits convenience and cheapness of management and potential Reduced manufacturing costs. Pulmonary delivery is also important and occurs in a variety of routes - via aerosols, metered dose inhalation systems (MDI), powders (dry powder inhalers, DPI) and solutions (Nebulizers), which can contain all nanostructures, such as e.g. Liposomes, micelles, nanoparticles and dendrimers. Aerosol Products intended for pulmonary administration account for more than 30% the global drug delivery market. Pulmonary drug delivery offers both local targeting and management respiratory diseases and appears to be an increasingly viable option for systemic drug delivery. Transdermal drug delivery avoids problems such as gastrointestinal irritation, metabolism, delivery changes speed and interference due to the presence of food. It is also suitable for unconscious patients. The technique is generally non-invasive and aesthetically acceptable, and can be used on top of it provide local delivery for several days. Restrictions include slow rate of penetration, lack of dosing flexibility and/or accuracy and a limitation to medicines with a relatively low dose24.

CONCLUSION:

The novel drug delivery system not only reduces repeated administration to overcome non-compliance, but also helps in increasing therapeutic value by reducing toxicity by increasing bioavailability and so on. Extensive investigation is underway for herbal remedies to include them in the novels drug delivery systems. Application of these new techniques to natural medicines will lead to better bioavailability, reduced toxicity, prolonged release action, protection against GI degradation that cannot be achieved through the conventional drug delivery system due to large molecular size, bad solubility, degradation of herbal medicines in Gastrointestinal media.

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