Vol 6| Issue 2| 2016 | 89-93.

e-ISSN 2248 – 9142
print-ISSN 2248 – 9134

International Journal of
Current Pharmaceutical & Clinical Research

www.ijcpcr.com

A REVIEW ON NOVEL DRUG DELIVERY SYSTEM: A RECENT TREND

Shaktipal Patil [*], Amrapali Mhaiskar, Dharmendra Mundhada

Agnihotri College of Pharmacy, Department of Pharmacology, Bapuji Wadi, Sindhi (Meghe), Wardha - 442 001, Maharashtra, India.

ABSTRACT

Plants are nature's remedies and have been used by human beings on earth since ancient times for food and medicine. Today there are global movements towards finding of herbal medicaments in plants to bring them in market via a suitable drug delivery system for mankind. The basic thought behind it is treatment of each disease is hidden in nature. However, delivery of herbal drugs also requires modification with the purpose to achieve sustain release, to increase patient compliance etc. previously 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 advancement in the technology, novel drug delivery systems (NDDS) open the door towards the development of herbal novel drug delivery system. With use of advance techniques protection from toxicity, enhancement in stability, improved bioavailability 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 value as well as reducing toxicity. The present reviews gives information regarding various novel techniques used for improving safety and efficacy of phytomedicines and application of novel formulation.

Key words: New drug delivery system, Phytosome, Nanoparticles, Microsphere, Transdermal Drug Delivery System.

INTRODUCTION

Herbal formulation means a dosage form consisting of 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 whole plant, fragmented or cut plants, plants parts to treatments such as distillation, extraction, expression, fractionation, purification, concentration or fermentation. These include comminuted or powdered herbal substances, tinctures, extracts, essential oils, expressed juices and processed exudates [1]. Herbal drug itself is 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 certain advantages over 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 reduce the repeated administration to overcome noncompliance, but also help to increase the therapeutic value by reducing toxicity and increasing the bioavailability. 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 a new approach 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.

Corresponding Author :- **Shaktipal Patil** Email:- shaktipalpatil@yahoo.com

1

Advantages of novel drug delivery system

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

Recent developments in novel drug delivery system of herbals

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

Phytosome

Phytosomes are 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 new 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 increases the absorption of active constituents, so its dose size required is small.
2. There is appreciable drug entrapment and improvement in the solubility of bile to herbal constituents, and it can target the liver.
3. In Phytosome, chemical bonds are formed between phosphatidylcholine molecules, so it shows good stability [11].
4. Phytosome improves the percutaneous absorption of herbal 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 liposomes are spherical particles that encapsulate the solvents which are freely floating in the interior [13].

Advantages of liposomes

1. The high biocompatibility.
2. The easiness of preparation.
3. The chemical versatility that allows the loading of hydrophilic, amphiphilic, and lipophilic compounds.

The simple modulation of their pharmacokinetic properties by changing the chemical composition of the bilayer components [14].

Nanoparticles

Nanotechnology is science of matter and material that deal with the particle size in nanometers. The word "Nano" is derived from Latinword, 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 [15]. Nanoparticles offer some specific advantages such as they help to increase the stability of drugs/proteins and possess useful controlled release properties. It can be 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 formulation directly to the site of action.
2. Increased efficacy and therapeutic index.
3. Increased stability via encapsulation.
4. Improved pharmacokinetic effect.
5. Producible with various sizes, compound surface properties [14].

Emulsions

Emulsion is a biphasic system in which one phase is intimately disperse 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 time because it is packed in the inner phase and makes direct.
2. contact with the body and 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 increase its concentration in liver, spleen and kidney.

4. As the emulsion contains herbal formulation, it will increase the stability of hydrolyzed formulated material and improve the penetrability of drug into skin and mucous.
5. The new type, viz., Elemenum emulsion, is used as an anti-cancer drug and causes no harm to the heart and liver [19].

Microsphere

Microsphere comprises of small spherical particles, with diameters in the micrometer range, typically 1 μm to 1000 μm (1 mm). Microspheres are sometimes referred to as micro-particles. Microspheres can be manufactured from various natural and synthetic materials. 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 dextranmicrospheres, 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 agent. Solid and hollow microspheres vary widely in density and therefore are used for different applications [20].

Advantage of microsphere formulation

1. Administration of medication 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 delivery of drugs and in some cases can even provide organtargeted release.
2. Drug can be easily released from the formulation.
3. It can protect the specific function of drugs, and can release the drugs into an outer phase for a long period.

Ethosomes

Ethosomes are developed by mixture of phospholipids and high concentration of ethanol. This carrier can penetrate through the skin deeply lead to improve drug delivery into deeper layer of skin and in blood circulation. These formulations are useful for topical delivery of alkaloids in form of gel and cream for patients comfort. They show increase in their permeability through the skin by fluidizing the lipid domain of the skin. Unstable nature and poor skin penetration are limits for Ethanosomes tropical delivery. The Ethosomes was developed and examined for their ability the 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. Result of the drug levels in rat plasma showed that when Tetrandrineloded Ethosomes were topically administered in rats the drug level was low to be detected in rat plasma. By providing fewer delivery of Tetrandrine into bloodstream, topical administration might offer favorable efficacy with reduced side effects, thus leading to improve patient's compliances. In conclusion, Ethosomes were demonstrated to be promising carrier for improving topical delivery of Tentrandrine via skin [21].

Advantages of ethosomal drug delivery

1. Ethosomes enhance transdermal permeation of drug through skin.
2. Ethosomes are a platform for the delivery of large amounts of diverse groups of drugs.
3. Ethosomal drud is administered in semisolid form resulting in improvement in patients compliance [22].

Solid Lipid Nanoparticles (SLN)

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

Advantages of SLN herbal formulation

1. It provides controlled release and site-specific drug targeting.
2. Large-scale production can be done.
3. In this formulation, both lipophilic and hydrophilic drugs can be loaded.
4. Another advantage is that it is made of lipid matrix (physiological lipids), which decreases danger of chronic and acute toxicity.

Niosomes

Niosomes are multilamellar vesicles formed from 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 different from liposomes in that they offer certain advantages over liposomes [25].

Proniosomes

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

Advantages of Proniosomes

1. More stable during storage and sterilization.
2. Easy to transfer and distribution

Transdermal Drug Delivery System

Transdermal drug delivery system has been an increased interest in the drug administration via the 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 present in the formulation permeates into the systemic circulation by diffusion to stratum corneum and further to the effected organ. These devices use polymer matrix, adhesive bandage and permeation enhancers.

Advantages of Transdermal Drug Delivery System

1. Controlled drug delivery, enhanced bioavailability, reduction in side effects and easy application.
2. Transdermal delivery of herbal drugs are to increase the penetration and sustained action.e.g.transdermal films containing boswellic acid (*Boswellia serrate*) and curcumin (*Curcuma longa*) were formulated for the treatment of inflammation (synergistic effect).
3. Limitations are hepatic first pass metabolism, increased herapeutic effect, and maintenance of steady state concentration in the serum [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].

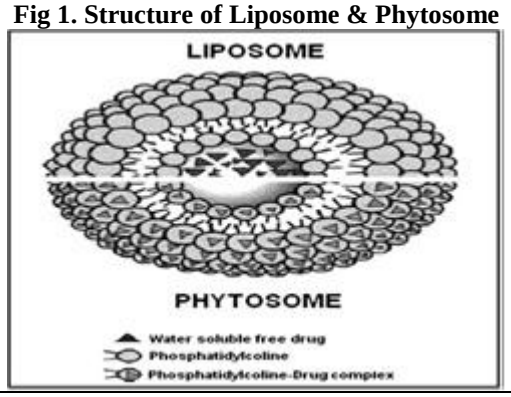
Liquid Crystals

Liquid Crystals combine the properties of both liquid and solid states. They can be made to from different geometries, with alternative polar and non-polar layers (i.e., a lamellar phase) where aqueous drug solutions can be included [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 release systems or as carriers in swellable and swelling-controlled release devices [30].

Fig 1. Structure of Liposome & Phytosome



CONCLUSION

Novel drug delivery system not only reduces the repeated administration to overcome non compliance, but also helps to increase the therapeutic value by reducing toxicity and increasing the bioavailability, and so on. Extensive research is going on for herbal drugs to incorporate them in novel drug delivery systems. Application of these novel techniques to natural medicines will led to enhanced bioavailability, reduced toxicity, sustained release action, protection from GI degradation which cannot be obtained through conventional drug delivery system due to large molecular size, poor solubility, degradation of herbal medicines in Gastrointestinal media.

ACKNOWLEDGEMENT

None

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Cott J. Natural product formulations available in Europe for psychotropic indications. *Psychopharmacol Bull*, 31, 1995, 745.
2. Atram S. Recent development of herbal formulation-a novel drug delivery system. *International Ayurvedic Medical Journal*, 2(6), 2014, 952-58.

3. Alexis F, Basto P, Levy NE, Radovic MAF, Zhang LF, Pridgen E, *et al*. HER-2-Targeted Nanoparticle Antiibody Bioconjugates for Cancer Therapy. *Chem Med Chem*, 3, 2008, 1839- 43.
4. Atmakuri LR, Dathi S. Current trends in herbal medicines. *J Pharm Res*., 3, 2010, 109-113.
5. Kumar K, Rai AK. Miraculous therapeutic effect of herbal drug using novel drug delivery system. *International Research Journal of Pharmacy*, 3(2), 2012, 27-30.
6. Musthaba S, Baboota S, Ahmed S, Ahuja A, Ali J. Status of novel drug delivery technology for phytotherapeutics. *Expert opinion Drug delivery*, 6(6), 2009, 625-37.
7. Muller RH, Runge SA. Solid lipid nanoparticles (SLN) for controlled drug delivery. In: Benita S, editor. Submicron emulsions in drug targeting and delivery. *Harwood Academic Pub*, 22(7), 1998, 219-234.
8. Jain NK. Controlled and Novel drug delivery, 4th edition, New Delhi: CBS Publishers and Distributers, 2002, 236- 237.
9. Amin T, Bhat SV. A Review on Phytosome Technology as a Novel Approach to Improve the Bioavailability of Nutraceuticals. *International Journal of Advancements in Research and Technology*, 1(3), 2012, 1-15.
10. Hikino H, Kiso Y, Wagner H, Fiebig M. Antihepatotoxic actions of flavonolignans from *Silybum marianum* fruits. *Planta Med*, 50, 1984, 248-50.
11. Kidd P, Head K. A Review of the Bioavailability and Clinical Efficacy of Milk Thistle Phytosome: A Silybinphosphatidylcholine Complex. *Altern Med Rev*, 10, 2005, 193-203.
12. Khar RK, Jain NK. Solid lipid nanoparticle as Novel Nanoparticle system in Targeted and controlled drug delivery. *IJPR*, 102-103.
13. Chaturvedi M, Kumar M, Sinhal A, Alimuddin Saifi. Recent development in novel drug delivery systems of herbal drugs. *International journal of Green Pharmacy*, 5, 2011, 87-94.
14. Kharat A, Pawar P. Novel drug delivery system in herbals. *IJPCBS*, 4, 2014, 910-930.
15. Maravajhala V, Papishetty S, Bandlapalli S. Nanotechnology In Development Of Drug Delivery System. International Journal of Pharmaceutics Science and Research, 3(1), 2012, 84-96.
16. Manmode AS, Sakarka DM, Mahajan NM. Nanoparticles- Tremendous Therapeutic Potential: A Review. *International Journal of PharmTech Research*, 1(4), 2009, 1020-1027.
17. Manach C, Scalbert A, Morand C, Remesy C and Jimenez L. Polyphenols: food sources and bioavailability. *Am J Clin Nutr*, 79, 2004, 727-747.
18. Jumaa M and Muller BW. Lipid emulsions as a novel system to reduce the hemolytic activity of lytic agents: Mechanism of protective effect. *Eur J Pharm Sci*, 9, 2009, 285-290.
19. Cui F, Wang Y, Wang J, Feng L, Ning K. Preparation of an entericsoluble solid-state emulsion using oily drugs. *Int J Pharma*, 338, 2007, 152-6.
20. Scarfato P, Avallone E, Iannelli P, Aquino RP. Qucertin microsphere by solvent evaporation: preparation characterization and release behavior. *J Appl Polymer Sci*, 109, 2008, 2994-3001.
21. Chao F , *et al*. Enhanced topical Deli very of Tetranderine by Ethosomes for Treatment of Arthritis. *Biomed Re search International*, 2013, 161943.
22. Touitou E. Godin B**.** Ethosome novel vesicular carrier for enhanced delivery: characterization and skin penetration properties**.** *J Cont Rel*, 3, 2000, 403-418.
23. Pople PV, Singh KK. Development and evaluation of topical formulation containing solid lipid nanoparticles of vitamin A. *AAPS Pharm Sci Tech*, 7, 2006, 91.
24. Gande S, Kopparam M, Vobalaboina V. Preparation characterization and *in vitro* and *in vivo* evalution of lovastatin solid lipid nanoparticle. *AAPS Pharm Sci Tech*, 8, 2007, 1-8.
25. Hunter CA. Vesicular System (Niosomes and Liposomes) for Delivery of Sodium Stibogluconate in Experimental Murine Visceral Leishmaniasis. *J Pharm Pharmacol*, 1988, 161-164.
26. Mishra AN. Controlled and novel drug delivery. In Jain NK editor. Transdermal Drug Delivery. New Delhi, CBS Publishers, 1997, 100-110.
27. Khan Y. Recent Advancements in Herbal Medicine–Novel Drug Delivery.
28. Jain NK. Controlled and Novel drug delivery, 4th edition, New Delhi, CBS Publishers and Distributers, 2002, 236-237.
29. Chauhan NS, Rajan G and Gopalakrishna B. Phytosomes: Potential phyto-phospholipid carriers for herbal drug delivery. *J Pharm Res*, 2(7), 2009, 1267-1270.
30. Muller Goymann CC. Physicochemical characterization of colloidal drug delivery systems such as reverse micelles, vesicles, liquid crystals and nanoparticles for topical administration. *Europ J of Pharmaceutics and Biopharmaceutics*, 58(1), 2004, 343-356.