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Review on Novel Herbal Drug Delivery System

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Review Article

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ABSTRACT

It has been claimed that employing proactive and plant selections, unique ayurvedic preparations such as polymeric nanoparticles, nanocapsules, liposomes, phytosomes, animations, microspheres, transfersomes, and ethosomes have been created. The novel formulations of plant actives and extracts are said to provide notable benefits over traditional formulations, such as improved dissolution rate, bioavailability, and toxicity safety; increased pharmacological activity; increased stability; better tissue macrophage distribution; success rate; and prevention from physical and chemical deterioration. A top manufacturer of pharmaceuticals and nutraceuticals created the patented phytosome technique to combine standardised plant extracts or water soluble phytoconstituents with phospholipids to create lipid-compatible chemical compounds. By combining the herbal medications into contemporary dose forms, they can be utilised in a more ethical manner with increased effectiveness. Designing new medicine delivery mechanisms for natural components can help achieve this. The current review highlights the state of innovative herbal formulation development and provides an overview of the types of active ingredients, biological activities, and novel formulations uses.

Keywords: Challenges; Herbal medicines; Liposome; Microsphere; Nanoparticle; Phytosome; Transferosomes

INTRODUCTION

Necessity of NDDS in herbal drugs

The limitations behind the conventional drug delivery methods are addressed by a novel drug delivery system, which is a novel method of drug administration. By precisely locating the diseased location within a patient's body then delivering the drug there, modern medicine may treat a specific condition. A drug delivery system is a way to supply the right amount of a medicine to the patient so that it precisely reaches the "site of action" and gets to work right away. The drawbacks of traditional drug delivery techniques all are addressed in novel drug delivery technologies. There are numerous methods for achieving novel drug delivery [1].

Currently, 95% of all investigational medications have poor pharmacokinetic and biopharmaceutical characteristics. In order to distribute therapeutically active drug molecules, decrease the effectiveness dosages, and increase therapeutic index and safety profiles in novel treatments, proper drug delivery schemes must only be constructed at the location without affecting healthy bodies and tissues.

Advantages of novel herbal drug delivery system

- They can be stored for at least a year and are site specific, biodegradable, and non-toxic.
- By adding specific ligands to particle surfaces or by using magnetic guidance, a drug can be directed to a specific location in the body.
- They provide controlled drug release rates and particle degradation characteristics that are simple to control by choosing the right matrix constituents.
- The loading of the medication is high, and drugs can enter the systems without a chemical reaction; this is a crucial element to protect drug operation.
- They provide better overall response/unit dose and therapeutic efficacy.
- The system can be applied *via* a variety of routes, including intraocular, maternal, nasal, and oral.

Disadvantages of novel herbal drug delivery system

- Bioacceptability has a range.
- Difficult to produce in large volumes.
- In addition to being difficult to handle physically in both liquid and dry form, nanoparticles can be aggregate due to their small size and large surface area.
- The limited loading, explosion, and small particle size all contribute to the large surface area. These practical issues need to be resolved before nanoparticles can be used in clinical or commercial settings.
- Future nanoparticle applications, surface modulation, drug loading techniques, release control, and the current work are all steps in the development of nanoparticle drug delivery systems.

LITERATURE REVIEW

Current challenges in upgrading and modernization of herbal formulations

- **Quality problems:** The primary issues that diminish the efficacy of herbal preparations and can be regarded as important variables impacting the quality and purity of herbal medicines include adulteration, misidentification of plants, poor collecting and preparation, and inappropriate formulation processes [2].
- **Problems in harvesting and processing:** Inadequate pre and post-harvest processes, indiscriminate harvesting, poor agricultural and propagation methods, and a lack of processing skills all contribute to the inferior quality of herbal medications.
- **Issues pertaining to quality control:** The biggest obstacles to maintaining the quality of herbal pharmaceuticals include standardisation, inadequate quality control practices, and a lack of Good Manufacturing Practices (GMP). In small and medium sized companies, it is also common for farmers and manufacturers to be unaware of the guideline, and for the guideline to not be implemented or regulated.
- **Administrative problems:** The lack of authority for regulation and control in the herbal sector, as well as inadequate monitoring and control, are essential to the quality of medicines [3].
- **Infrastructure related problem:** The main issues are a lack of processing skills, skilled workers, sophisticated equipment, the application of modern techniques, and local instrument fabrication facilities.
- **Pharmacogivilane:** To obtain toxicological data and adverse effects of herbal medications, effective pharmacogivilance in the herbal industry is now required. It's important to thoroughly monitor harmful responses, contraindications, reactions with other medications, foods, and traditional drugs.
- **Clinical trial:** Because the safety of using herbal medicines continues to be a major concern, clinical studies are required to determine the safety and effectiveness of these medications before introducing them to the worldwide market [4].

- **IPR and bio piracy:** The main obstacle to the promotion of herbal traditional medicine is bio piracy. Thus, recording traditional knowledge is crucial for the future.
- **Unreasonable use:** It's a common misconception that herbal products have no side effects or interactions, but sadly this is untrue. Therefore, the irrational use of these drugs can result in a number of issues that could impede their promotion.
- **R&D:** Research and development on dosage, processing, and techniques is essential for any drug, but it is significantly less common in the herbal sector than it is in allopathic medicine. Nevertheless, the trend has changed in recent years. Research is required to comprehend the mode of action and pharmacokinetics phenomenon, as well as to improve/create monographs and reference standards for marker based analysis. Another issue for a sustainable, socio-culturally equitable, and safe supply of herbal medicines is the glaring gap between modern ethnopharmacological research and modern research on medicinal plants [5].

Approaches in novel herbal drug delivery systems

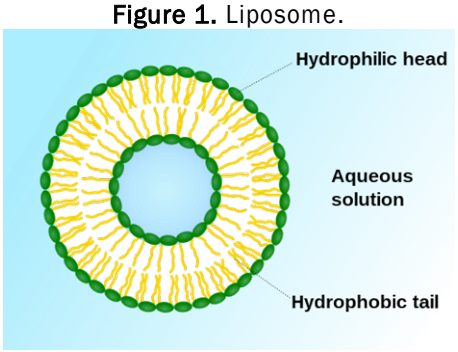
Types of novel herbal formulations

- Liposomes
- Phytosomes
- Niosomes
- Ethosomes
- Transferosomes
- Microsphere
- Microemulsion
- Nanoparticles

Liposomes

The spherical liposomes include a portion of the solvents, which is allowed to freely permeate (float) into their core. Condensed phospholipid bilayers vesicles with an entirely confined aqueous volume are called liposomes. A lipid membrane bi-layer made primarily by phospholipids, whether they are organic or manufactured. The Head Greek terms "Lipos," which represents fat, and "Soma," which denotes flesh, are the origin of the phrase "liposome." The size of a liposome can be generated as single or multi-lamella the home, and its name refers to its phospholipid building components rather than its size the size. Even if a liposome does not contain a lipophobic substance like water, commonly does. frequently does. Liposomes are synthetic lipid-bilayer bilayer vesicles. Liposomes to administer medications for cancer and other diseases, drugs may be filled. It is possible to prepare biological membranes using sonic disruption. They are micro particulate or colloidal carriers that spontaneously form in aqueous media as these lipids hydrate, typically ranging in diameter from 0.05 m to 5.0 m. A relatively biocompatible, biodegradable, and aqueous substance makes up liposomes. A quantity of lipids, either natural or synthetic, entangled in one or more bilayers. A wide range of pharmaceuticals the captured amount of aqueous substances can be encapsulated in liposomes either in the bilayer of phospholipids or at the interface of the two layers, depending on their lipophilicity (Figure 1) [6].

Figure 1. Liposome.



Methods of liposome preparation

- Mechanical dispersion method.
- Solvent dispersion method.
- Detergent removal method (removal of non-encapsulated material)

Mechanical dispersion method:

The types of mechanical dispersion techniques include the following:

- Freeze thawed liposomes.
- Lipid film hydration by hand shaking, non-hand shaking or freeze drying.
- Micro-emulsification.
- French pressure cell: extrusion.
- Membrane extrusion
- Sonication.

Advantages of Liposome

- Gives tumour tissues specific passive targeting (Liposomal doxorubicin).
- Improved therapeutic index and efficacy.
- Additional stability through encapsulation.
- Decrease in the encapsulated agents toxicities.
- Effect of site avoidance.
- Better pharmacokinetic results.
- Ability to combine with ligands that are specific to a given site to produce active.

Disadvantages of liposome

- Minimal bioavailability.
- A short half-life.
- The phospholipid can occasionally experience an oxidation and hydrolysis like process.
- Losses and fusion of drug/molecule encapsulations.
- Increasing production costs.
- Less stables.

Phytosomes

Introduction: Pharmaceuticals with clinical value have frequently been derived from natural products. To create lipid soluble complexes, hydrophilic constituents could be combined with clinically beneficial nutrients like phospholipids. Phytosomes, which resemble liposome like vesicles, can be made using these complexes. In contrast, no chemical bond is created in liposomes, and phosphatidylcholine molecules merely encircle the water soluble components. These hydrophilic active ingredients bioavailability is significantly increased by phytosomes. By increasing absorption in the gastrointestinal tract, phytosomes are reported to increase the bioavailability of plant based medications that are poorly lipid soluble [7-13].

Method of preparation

In a Round Bottom Flask (RBF), phosphatidylcholine and cholesterol were accurately weighed and then dissolved in 10 ml of chloroform and sonicated for 10 min using a bath sonicator. Rotary evaporators (45°C–50°C) are used to remove organic solvents. After the solvent had been entirely removed, a thin layer of the phospholipid mixture had developed. This film was hydrated in a rotary evaporator at 37°C–40°C for an hour using a plant methanolic extract. Following hydration, a lipid and plant extract mixture was sonicated for 20 minutes in an ice bath to dissipate heat. After that, prepared phytosomes were placed in amber bottles and kept in the freezer (2°C–8°C) until needed [14].

Advantages of phytosome

- Combining the effects of using hepatoprotective substances.
- Greater benefit to therapy.
- More favourable stability profile.
- Significant drug entrapment.
- Reduced dosage necessary.
- It has the ability to penetrate the hydrophilic botanical extract, enhancing intestinal lumen absorption.
- Because phytosome enhance the absorption of active ingredients, a small dose is needed.
- Targeting the liver results in observable drug entrapment and an enhancement in the solubility of bile in relation to herbal ingredients.
- Because phosphatidylcholine molecules in phytosomes form chemical bonds, they are stable.
- The percutaneous absorption of herbal phytoconstituents is enhanced by phytosome.

Disadvantages of phytosome

- Phytosomes have a number of benefits, but they also have some deadly drawbacks, such as the ability of phospholipids (lecithin) to promote the growth of the MCF-7 breast cancer cell line.

- Leaching of the phytoconstituents off the phytosome, which lowers the desired drug concentration and indicates their unstable nature, is a significant drawback of phytosome.

Niosomes

Introduction: Niosomes are a cutting-edge drug delivery system that encapsulates the medication in a vesicle. Non-ionic surfactants are divided into a bilayer to form the vesicle. Because they are stable and affordable, niosomes are generally preferred to liposomes. By delaying the drug's removal from circulation, shielding it from the biological environment, and limiting the effects to the target cells only, niosomes enhance the pharmacological action of drug molecules. As a carrier in haemoglobin, for the oral administration of peptide pharmaceuticals, for the treatment of leishmaniasis, for ocular delivery, and for cutaneous drug delivery, it is utilised in innovative drug delivery for the treatment of cancer [15].

Methods of preparation

- Hand shaking method (Thin film hydration technique).
- Reverse Phase Evaporation (REV).
- The Bubble Method.
- Sonication.
- Micro fluidisation.
- Ether Injection Method.
- Multiple extrusion method.
- Trans membrane pH gradient (inside acidic).
- Formation of niosomes from proniosomes.

Advantages of niosomes

- Maximum duration of action and reduced side effects.
- When compared to other delivery methods, patient compliance is higher.
- The amount of drug needed to produce the desired effect is very small.
- The preparation's active ingredient or constitutent is shielded by a bilayer from various external and internal factors.
- Act as depot formulation, allowing for controlled drug release.
- Drug is guarded against gastrointestinal breakdown and first pass metabolism.
- Even in emulsion form, have a stable structure.
- Niosomes can be administered parenterally, topically, or orally.

Disadvantages of niosomes

- Process has required more time.
- For processing special equipment are needed.
- Physically unstable.

Ethosomes

Introduction: As yet another new lipid carrier made of ethanol, phospholipids, and water, ethosomes were created by Touitou, et al. in 1997. They are said to enhance how well different medications are delivered to the skin. The intercellular area of the stratum corneum is thought to be affected by ethanol, which is a powerful penetration enhancer. Ethosomes are soft, flexible vesicles that are mostly made up of phospholipids, ethanol (at a relatively high concentration), and water. These soft vesicles are new vesicle carriers that will enable better distribution through the skin. The ethosome vesicles sizes can vary from tens of nm to microns [16].

Method of preparation

- Hot method
- Cold method

Cold method:

This technique for ethosomal preparation is the most popular and widely used one. The drug, phospholipids, and other lipid components are dissolved in ethanol with vigorous stirring at room temperature. Into a water bath, the mixture was heated to 30°C. In a separate vessel, the water is heated to 30°C before being added, combined, and stirred for five minutes. The ethosomal formulation's vesicle size can be reduced, if desired, by extrusion or sonication. Finally, the formulation needs to be properly refrigerated stored [17].

Advantages of ethosome

- Ethosomes improve the drug's transdermal and dermal absorption through the skin.
- Ethosomes serve as delivery systems for a wide range of medications.
- Low risk profile because the toxicological profiles of the ethosome components are well-documented in the scientific literature, there is no risk associated with large-scale drug development with this technology.
- High patient compliance is achieved when the ethosome drugs are administered in a semisolid form (gel or cream). Iontophoresis and phonophoresis, on the other hand, are relatively difficult to use, which will impact patient compliance.
- High market appeal for products using patented technology Ethosome production is relatively easy to do and doesn't require any expensive technical investments.
- Various uses in the medical, veterinary, and cosmetic industries.

Disadvantages of ethosome

- Ethosomal administration is typically intended to provide slow, sustained drug delivery, not rapid bolus type drug input.
- The drug must be sufficiently soluble in both lipophilic and aqueous environments in order to enter the dermal microcirculation and the systemic circulation.
- The drug's molecular size should be appropriate for percutaneous absorption.
- Some types of skin may not respond well to adhesive.
- Possibly not economical.
- Bad yield.
- Drug delivery system excipients and enhancers can cause skin irritability or dermatitis.
- If shell locking fails, the ethosomes may coalesce and disintegrate when transferred into water.
- Product loss when switching from organic to water media.
- Ethosomes' primary benefit over liposomes is the increased permeation of the drug.

Transferosomes

Introduction: In 1991, Gregor Cevc created a concept as well as definition of transfersome. The title is taken from "transferred," a Latin word meaning "to carry," "to convey," as well as "soma," a Greek word that meaning "body." Translation is a manufactured carrier. A vesicle like the cell's typical vesicle. As a result, it is appropriate for controlled and focused medication delivery. Transfersome is a dynamic aggregate that responds quickly to stress and is extremely flexible. It is a complicated fat bilayer encasing an aqueous core in a deformable vesicle bilayer of fat. The composition of the area and the bilayer's shape both affect the vesicle. Both self-regulation and self-improvement this facilitates the user's passage across many efficient communication obstacles and serves as a non-intrusive target medication. These elements self-optimization. Drugs may be reliably delivered into or through the ultra flexible membrane. The skin is of good quality, depending on the method of application or administration. These transfers are a great fit for skin penetration since they are many orders of magnitude more elastic than the normal liposome. To block skin penetration, the transfers are forced *via* the intracellular lipid of the stratum corneum. The proper fusion of surfactive components results in the transfersoma membrane's flexibility [18].

Method of preparation

- Thin film hydration method.
- Modified hand shaking lipid film hydration method.

Thin film hydration method

Using a rotary evaporator, a thin film is created by dissolving phospholipids and surfactants in an appropriate organic medium, such as chloroform-methanol. At a temperature of 500°C, the organic solvent began to evaporate. After adding a saline phosphate buffer with a pH of 6.4 to the film's hydrate stack, it was rotated at 60 revolutions per minute for an hour and then left at room temperature for two hours to finish the vesicle's swelling process. The dispersion is then sonicated to the desired size [19].

Advantages of transferosomes

- Transfers are capable of producing minor constriction (5–10 times smaller). Other than their own diameter, there was no discernible loss.
- Capture efficiency of roughly 90% when it comes to lipophilic medicine.
- The intact vesicles can penetrate more deeply due to this high deformity.
- They are able to deliver both high and low molecular weight medications, such as analgesics.
- Bluetongue, a narcotic, corticosteroids, a hormone that affects gender, an anticancer, insulin, and albumin.

- Hydrophobic and hydrophilic infrastructure exist in transfers. Drug molecules with a wide range of solubilities collectively and as a result.
- They perform the role of a warehouse, gradually releasing their contents.

Disadvantages of transferosomes

- Due to their propensity for oxidative degradation, transfersomes are chemically unstable.
- Another factor that prevents transfersomes from being used as drug delivery systems is the purity of natural phospholipids.
- Costly formulations for transfersomes.

Microsphere

Introduction: Systems for delivering drugs to specific body sites have a significant impact on the healthcare system. Consequently, carrier mediated technology discovers the intelligent approach for novel drug delivery by coupling the drug to carrier particles such as microspheres, nanoparticles, and liposomes. The ideal drug delivery system delivers the drug at a rate determined by the body's need throughout the course of treatment. The most preferred method of taking medication is through the oral route of administration. 1 small, spherical particles with a diameter of 1 um to 100 um are called microspheres. They are biodegradable natural particles that are free flowing and made of proteins or synthetic polymers. Two different kinds of microspheres exist [20].

- Microcapsule entrapped substance distinctly surrounded by distinct capsule wall.
- The substance that is micromatricess entrapped is distributed throughout the matrix. Delivering the agent becomes necessary in order to achieve the maximum therapeutic efficacy because controlled drug delivery systems solve the issues with conventional therapy and increase the therapeutic efficacy of a given drug. The development of a new drug delivery system for controlled drug release uses microspheres.

Method of preparation:

- Solvent evaporation.
- Double emulsion technique.
- Spray drying and spray congealing.
- Solvent extraction.
- Single emulsion technique.
- Quassi emulsion solvent diffusion.
- Spray drying.
- Phase separation coacervation technique.

Spray drying

In the spray drying process, the polymer is firstly dissolved in a volatile organic solvent like acetone or dichloromethane. The drug is then homogenised at a high speed and dispersed in a polymeric solution. Then, a hot air stream atomizes this dispersion. When a substance is atomized, it creates tiny droplets from which the solvent instantly evaporates, creating microspheres that range in size from 1 to 100 m. The cyclone separator separates micro particles from hot air while vacuum drying eliminates any remaining solvent. One of this process's main benefits is its ability to operate in aseptic conditions.

Advantages of microspheres

- They offer protection for unstable drugs both before and after administration.
- In locations other than the tissue or the target organ, they decreased drug concentration.
- Reduce toxicity and dose.
- Reduction of particle size to improve poorly soluble drug solubility.
- Ensure a consistent and long lasting therapeutic effect.

Disadvantages of microspheres

- When compared to standard formulations, the costs of the materials and processing for a controlled release preparation are significantly higher.
- The rate of controlled release of microspheres may vary depending on intrinsic or extrinsic factors, such as food, the speed at which it travels through the gut, the rate at which mucin changes, etc.
- How polymer matrix is disposed of and what impact it has on the environment.
- There are variations in release from one dosage form to another.
- Any degradation of the release pattern could potentially be toxic.
- How additives to polymers, like plasticizers, stabilisers, antioxidants, and filers, fare.

- Less replication is possible.
- In the case of parental microspheres, minimal drug loading is carried out.
- Process conditions like temperature change, pH change, solvent addition, and evaporation/agitation may have an impact on how stable the core particles are before encapsulation.
- Microspheres delivered *via* the parent may interact or combine with blood components.
- Impact on the environment of the polymer matrix's degradation products as a result of heat, hydrolysis, oxidation, solar radiation, or biological agents.

Microemulsion

Introduction: Micro emulsions are liquid mixtures of oil, water, and surfactant that are clear, stable, and isotropic; they frequently also contain a cosurfactant. Salt(s) and/or other ingredients may be present in the aqueous phase, and the "oil" may actually be a complex mixture of various hydrocarbons and olefins. Micro emulsions, in contrast to ordinary emulsions, are formed by the simple mixing of the components and do not call for the high shear conditions that are typically used to create ordinary emulsions. Oil dispersed in water is known as a direct micro emulsion, and water dispersed in oil is known as a reverse micro emulsion. Surfactant molecules may form a monolayer at the interface between the oil and water in ternary systems like micro emulsions, where two immiscible phases (water and "oil") are present with a surfactant. In the same way that self-assembled structures of different types can form in binary systems (water/surfactant or oil/surfactant).

Method of preparation

The drug is dissolved in the micro emulsion's lipophilic portion, which is made up of the oil and water phases combined with a surfactant. Cosurfactant is then slowly added while the mixture is being constantly stirred, and the process is repeated until the mixture is transparent. The pseudo ternary phase diagram is used to calculate the quantity of surfactant as well as cosurfactant to be added as well as the percentage of oil phase that can be incorporated. Finally, the use of an ultrasonicator enables the desired size range for dispersed globules. It is then given time to balance. A gelling agent can be added to the aforementioned micro emulsion to create gel. The most popular gelling agent is carbomers, which are polyacrylic acid polymers that have been crosslinked.

Advantages of micro emulsion

- Micro emulsions are thermodynamically stable systems that enable the system to self-emulsify.
- For drugs, micro emulsions function as super solvents.
- Both hydrophilic and lipophilic medications, as well as those that are largely insoluble in both aqueous and hydrophobic solvents, can be solubilized by them.
- Drugs that are hydrophilic or lipophilic may be stored in the dispersed phase, which can be Oil in Water (O/W) or Water in Oil (W/O) micro emulsions, respectively. Depending on the volume of the dispersed phase, the drug's partition, and the rate of transport, pseudo-zero-order kinetics for drug release can be achieved.
- In a micro emulsion, the mean droplet diameter is less than 0.22 mm. When absorption (*in vitro or in vivo*) occurs, the drug is rapidly released into the external phase from the small size of the droplet in micro emulsions, such as below 100 nm, maintaining the concentration in the external phase close to initial levels.
- The same micro emulsions can transport both hydrophilic and lipophilic drugs.
- Micro emulsions are simple to make and don't require a lot of energy to prepare because of their thermodynamic stability. The viscosity of micro emulsions is lower than that of primary and multiple emulsions.
- A drug's effectiveness can be increased by using micro emulsion as a delivery system, which reduces the overall dose and lessens side effects.

Disadvantages of micro emulsion

- To stabilise the droplets of the micro emulsion, a high concentration of surfactant and co-surfactant must be used.
- Low system solubilizing ability for materials with high melting points.
- In order to be utilised in pharmaceutical applications, the surfactant must be nontoxic.
- The stability of micro emulsions is affected by environmental factors like pH and temperature. As patients receive micro emulsion, these variables change.

DISCUSSION

Nanoparticles

Introduction: Nanotechnology is the study of very small objects. It involves in use and tinkering with of matter. At this

scale, atoms and molecules function differently and offer a wide range of unexpected and fascinating applications. Studies on nanotechnology and nanoscience have exploded over the past few years in a variety of product domains. It offers chances for the creation of materials, including those for medical uses, where more traditional methods might have their limitations. It is incorrect to think of nanotechnology as a single technique that only affects certain fields. Although it is frequently called the "tiny science," nanotechnology encompasses more than just extremely tiny objects and materials. Bulk materials and large surfaces frequently contain nanoscale features. Design and production are represented by nanotechnology. In order to create new nanosized materials, nanotechnology entails the design, production, and application of materials at the atomic, molecular, and macromolecular scales. Pharmaceutical nanoparticles are solid, submicron-sized drug carriers with a diameter of less than 100 nm that may or may not be biodegradable. Nanospheres and nanocapsules are collectively referred to as nanoparticles. In contrast to nanocapsules, which have a special polymeric membrane surrounding the drug, nanospheres are matrix systems in which the drug is uniformly dispersed.

Method of preparation

Mechanical methods
- High energy ball milling.
- Melt mixing.

Methods based on evaporation
- Physical vapour deposition.
- Laser ablation.

Chemical methods
- Colloids synthesis.
- Synthesis of metal nanoparticles by colloidal method.
- Sol-Gel method.

Biological methods
- Synthesis using plant extracts.
- Synthesis using DNA.

Colloids synthesis: These are spherical particles, rods, tubes, plates, and other sub micrometer phase separated particles. These are the particles that are floating in a warm matrix. In either an aqueous or non-aqueous medium, particles of different sizes and shapes of metal, alloy, semiconductor, and insulator can be created. Colloidal synthesis is a very old technique. Gold nanoparticles were created by M. Faraday using a wet chemical process. Particles are extremely stable. In a glass reactor, colloidal particles are created from scratch. Glass reactors have an opening for the introduction of gases and precursors as well as for temperature, pH, and other reaction related measurements. The products may be removed at appropriate intervals. The reaction is conducted in an inert atmosphere to prevent the products from oxidising uncontrollably.

Advantages of nanoparticles
- It is simple to manipulate the surface properties and particle size of nanoparticles to target drugs passively and actively after parenteral administration.
- In order to achieve maximum therapeutic efficacy with a minimum amount of drug side effects, the surface of the nanoparticle can be altered to change how drugs are distributed in the body and then cleared from the body.
- By selecting the right matrix constituents, controlled release and particle degradation characteristics can be easily modified.
- This is a crucial aspect for maintaining the drug activity because drug loading is relatively high and drugs can be incorporated into the systems without causing any chemical reactions.
- By adding targeting ligands to the surface of the particles or by using magnetic guidance, site-specific targeting can be accomplished.
- Liposomes and nanoparticulates made of polymers are typically biodegradable, do not build up in the body, and may therefore be risk free.
- Smaller capillaries can be penetrated by nanoparticles of smaller sizes, which might enable effective drug accumulation at the target sites.
- There are numerous ways to administer medication, such as orally, nasally, parenterally, intravenously, etc.

Disadvantages of nanoparticles
- Due to their smaller size and higher surface area, altered physical properties of nanoparticles cause them to aggregate and are difficult to handle physically in both liquid and dry forms.

- Since surface area increases with particle size, nanoparticles are highly reactive in the cellular environment.

CONCLUSION

Since ancient times, herbal medicines have been used extensively throughout the world, and both doctors and patients have recognised their superior therapeutic value due to the fact that they have fewer side effects than modern pharmaceuticals. By incorporating Ayurvedic medicines into contemporary dosage forms, they can be used in a more ethical manner with increased efficacy. Designing NDDS for herbal ingredients can achieve this. NDDS help to increase the therapeutic value by decreasing toxicity, increasing bioavailability, and other factors, in addition to reducing the need for repeated administration to combat noncompliance. Pharmaceutical scientists have recently shifted their attention to developing a scientifically sound drug delivery system for herbal medicines. The innovative research can help in both market entry and market retention. However, there are a number of difficulties with herbal drugs that need to be resolved, including the difficulty of conducting clinical research in herbal drugs, the development of straightforward bioassays for biological standardisation, the development of pharmacological and toxicological evaluation methods, the investigation of their sites of absorption, the use of toxic herbal drugs, the identification of various animal models for toxicity and safety evaluation, the legal and regulatory aspects of herbal drugs, and others.

REFERENCES

1. Kusum Devi V, et al. Villi Importance of novel drug delivery systems in herbal medicines. Pharmacogn Rev. 2010;4.
2. Kumar R, et al. A Review on novel drug delivery system. Int J Res Anal Rev. 2021;8:183-199.
3. Ahlam Mushtaq, et al. "Phytochemical screening, physicochemical properties, acute toxicity testing and screening of hypoglycaemic activity of extract of *Eremurus himalaicus* Baker in normoglycaemic wistar strain albino rats." Biomed Res Int. 2014:867547.
4. Saikat Sen, et al. Raja Chakraborty Revival, modernization and integration of Indian traditional herbal medicine in clinical practice: Importance, challenges and future. J Tradit Complement Med. 2017;7:234-244.
5. Sharma P, et al. Global need for novel herbal drug formulations. Int J Pharmacogn Phytochem Res. 2016;8:1535-1544.
6. Chaturvedi M, et al. Recent development in novel drug delivery systems of herbal drugs. Int J Green Pharm. 2011;5.
7. Singh B, et al. Phytosome: Most significant tool for herbal drug delivery to enhance the therapeutic benefits of phytoconstituents. J Drug Deliv Ther. 2018;8:98-102.
8. Arumugam K, et al. Niosomes: A novel carrier drug delivery system. J Drug Deliv Ther. 2021;11:162-170.
9. Poonam Verma K, et al. Therapeutic and cosmeceutical potential of ethosomes: An overview. J Adv Pharm Technol Res. 2010;1:274-284.
10. Aggarwal D, et al. Ethosomes: A review. Int J Pharm Med Res. 2016;4:354-363.
11. Pradeep C, et al. Herbal novel drug delivery systems and transferosomes. J Drug Deliv Ther. 2018;8:162-168.
12. Solanki D, et al. Transferosomes-A review. World J Pharm Pharm Sci. 5:435-449.
13. Mahale Manisha M, et al. Microsphere: A review. J Drug Deliv Ther. 2019;9:854-856.
14. Kumar Das M, et al. Microsphere a drug delivery system-A review. Nat J Curr Pharm Res. 2019;11:34-41.
15. Madhav S, et al. A review on micro emulsion based system. Int J Pharm Sci Res. 2011;2:1888-1899.
16. Ranjit K, et al. Nanoparticle: An overview of preparation, characterisation and application. Int Res J Pharm. 2013:4:47-57.
17. Singh RP, et al. Phytosome: Recent advance research for novel drug delivery system. Asian J Pharm Res Dev. 2014;2:15-29.
18. Choudhury A, et al. Microsphere: A promising approach for drug delivery. J Appl Pharm Res. 2019;7:1–6.
19. Chidambaram M, et al. Drug-drug/drug-excipient compatibility studies on curcumin using non-thermal methods. Adv Pharm Bull. 2014;4:309-312.
20. Patel R, et al. Significance of various chromatographic techniques. J Chem Pharm Res. 2016;8:877-882.