



A review article of Novel drug delivery system

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Abstract

Over the past several years, great advances have been made on development of novel drug delivery systems (NDDS) for plant actives and extracts. The variety of novel herbal formulations like polymeric nanoparticles, nanocapsules, liposomes, phytosomes, nanoemulsions, microspheres, transferosomes, and ethosomes has been reported using bioactive and plant extracts. The novel formulations are reported to have remarkable advantages over conventional formulations of plant actives and extracts which include enhancement of solubility, bioavailability, protection from toxicity, enhancement of pharmacological activity, enhancement of stability, improved tissue macrophages distribution, sustained delivery, and protection from physical and chemical degradation. The present review highlights the current status of the development of novel herbal summarizes their method of preparation type of active ingredients, size, entrapment efficiency, route of administration, biological activity and applications of novel formulation.

Keywords: Transferosomes, Sustained, Bioavailability, Summaries, Novel.

INTRODUCTION

There are various distinct carriers with advantages over the base kinds in innovative drug delivery systems (NDDS). Traditional dosage forms have a high dose and limited availability, inconsistency, first pass effect, variation of plasma drug levels, and rapid release of medicinal compounds. By: performance, protection, patient compliance, and product shelf life.¹ NDDS will mitigate the problems. Nanoparticles are gaining popularity as people become more aware of their potential implications on human health and environmental sustainability, as well as the improved environmental performance of human-made nanoparticles.² Nanoparticles are employed in a variety of applications and are produced through several procedure Interesting theoretical problems are their calculation and characterisation.

Nanoparticles are defined as those having a diameter between 10 and 100 nm. Their pharmacologic and pharmacokinetic features are altered to provide a tailored supply mechanism for the distribution of small and big molecules.³ They can be defined as a system in which a dissolved active ingredient is encapsulated or adsorbed in the matrix material utilised to supply the target tissue. The influence of medication on the target tissue has been demonstrated to improve enzyme retention stability and intravascular solubilisation of nanoparticles.⁴ Some parameters must

be considered while designing nanoparticles, such as their release pattern, size, and surface features, which determine the specific site activity at optimum rates with the appropriate dosing scheme.⁵ The earliest nanoparticles discovered were made from a polymeric non-biodegradable framework (polyacrylamide, polymethyl-methacrylate, polystyrene). The polymeric nanoparticles may include drugs or proteins, ie (s).⁶ These bioactives are trapped as particulates or solid solutions in the polymer matrix, or they may be physically or chemically attached to the surface of the particle.

A drug is described as a dissolved, trapped, encapsulated, or nanoparticle-attached nanoparticle matrix that is a particulate dislocation or a solid particulate with a size of 10 to 1000 NM.⁷ Nanoparticles are solid particles that can be amorphous or crystalline 4-7, similar to nanospheres and nanocapsules ranging in size from 10 to 200 nm. Polymeric materials were widely used in the production of nanoparticles. Nanoparticles, nanospheres, and nanocapsules can all be produced depending on the method used nanocapsules are systems in which the medicinal product is contained within a cavity with a specific polymeric membrane, whereas nanospheres are matrix systems that physically and reliably spread pharmaceutical products.⁸

Niosomes are a new form of drug delivery technology that encapsulates the medication inside a vesicle. The vesicle is made up of a bilayer of surface active, non-ionic molecules. Hence the term "Niosomes" Niosomes include a variety of small and microscopic components.⁹ Their dimensions are measured on the nanometre scale. While physically identical to liposomes, they have a number of benefits over them. A recent study discovered that Niosomes significantly improve transdermal pharmaceutical delivery and can also be employed in specialised medicine administration, sparking a boom in research on these structures, which possibly offer fresh techniques to distribution. 10. The development of novel drug delivery systems (NDDS) for herbal remedies has received a lot of attention in recent decads. The innovative carriers must meet two requirements. The medicine should be administered at a rate that is consistent with the body's needs during treatment. Second, the active ingredient in the herbal drug should be delivered to the intended site of action. Conventional and extended-release dosage formulations cannot meet all of these specifications.¹¹ In phytoformulation research, creating nano Liposomes, a biodegradable and non-toxic vehicle capable of encapsulating both hydrophilic and hydrophobic materials, has the potential to improve the therapeutic index of anti-cancer agents by increasing drug concentration and overcoming problems associated with plant medicines.¹²

This material has several advantages, including good biocompatibility, ease of production, and chemical diversity for loading hydrophilic chemicals. Amphiphilic and lipophilic compounds; and iv) simple Changing the chemical composition of bilayer components may influence their pharmacokinetic properties.¹³ Drug transport into the reticuloendothelial system (RES) is Most common liposomes are trapped, making it straightforward to do. By the RES. [The application of creative approaches can improve the efficacy of herbal cosmetic formulae on the human body. Several of them are summarised in the present. . Many well-known herbal extracts, including ginseng, green tea, milk this grape seed, hawthorn, and ginkgo biloba, have been treated with the phytosome technique.¹⁴ These plant extracts' flavonoid and terpenoid components are well suited for direct binding to cholinergic phosphate. A phytosome is formed by binding individual components of herbal extracts to phosphatidyl choline, resulting in a more easily absorbed dose form and thus superior results when compared to typical herbal excerpts.¹⁵ The results reveal that silybin absorption from silybin phytosomes is nearly seven times more than silybin absorption from regular milk thistle extract.

Types of novel drug delivery system :

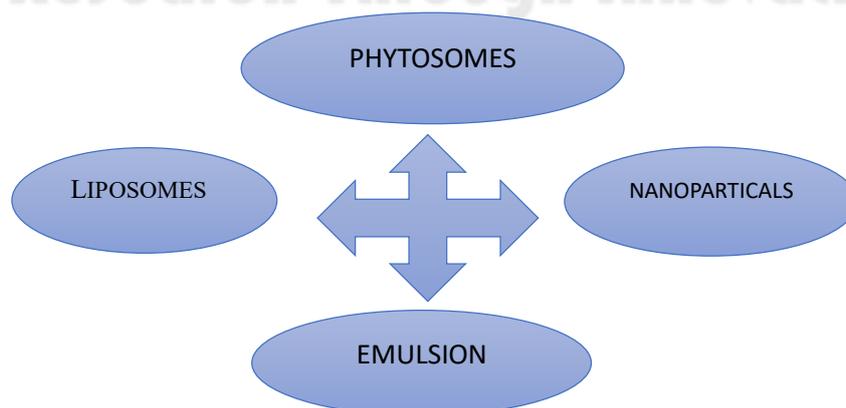


Fig no.1: Novel drug delivery system

LIPOSOMES: Liposomes are spherical particles that enclose a portion of the solvent while allowing it to freely permeate (float) within them. Concentric membranes might be single, many, or a combination.¹⁶ Liposomes are composed of polar lipids containing both lipophilic and hydrophilic groups. When polar lipids interact with water, they self-assemble and form colloidal particles. Detergents generate micelles, however polar lipids with hydrophobic parts cannot form micelles with large curvature radii.¹⁷ Instead, they create bilayers that can close themselves into liposomes.

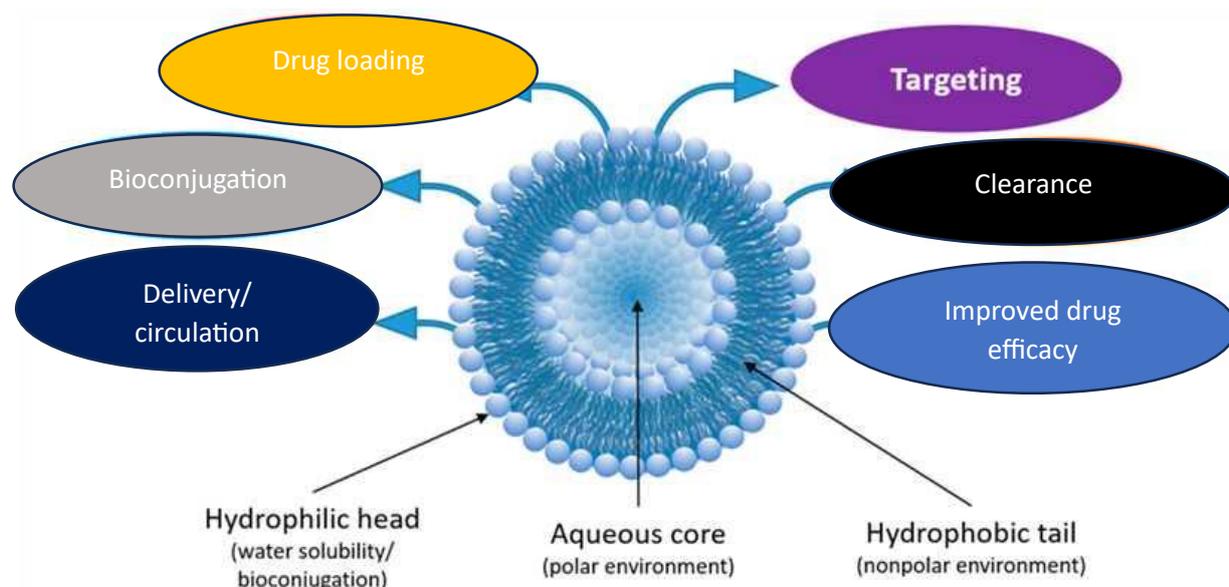


Fig no.2: Liposomes

PHYTOSOMES: Research on phytochemicals and phytopharmacology has revealed the biological activity, content, and health benefits of plant products throughout the past century. and health benefits of plant products throughout the past century.¹⁸ The vast majority of plants' biologically active components are polar or water-soluble compounds. However, water-soluble phytoconstituents (flavonoids, tannins, terpenoids, etc.

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PHYTOSOMES

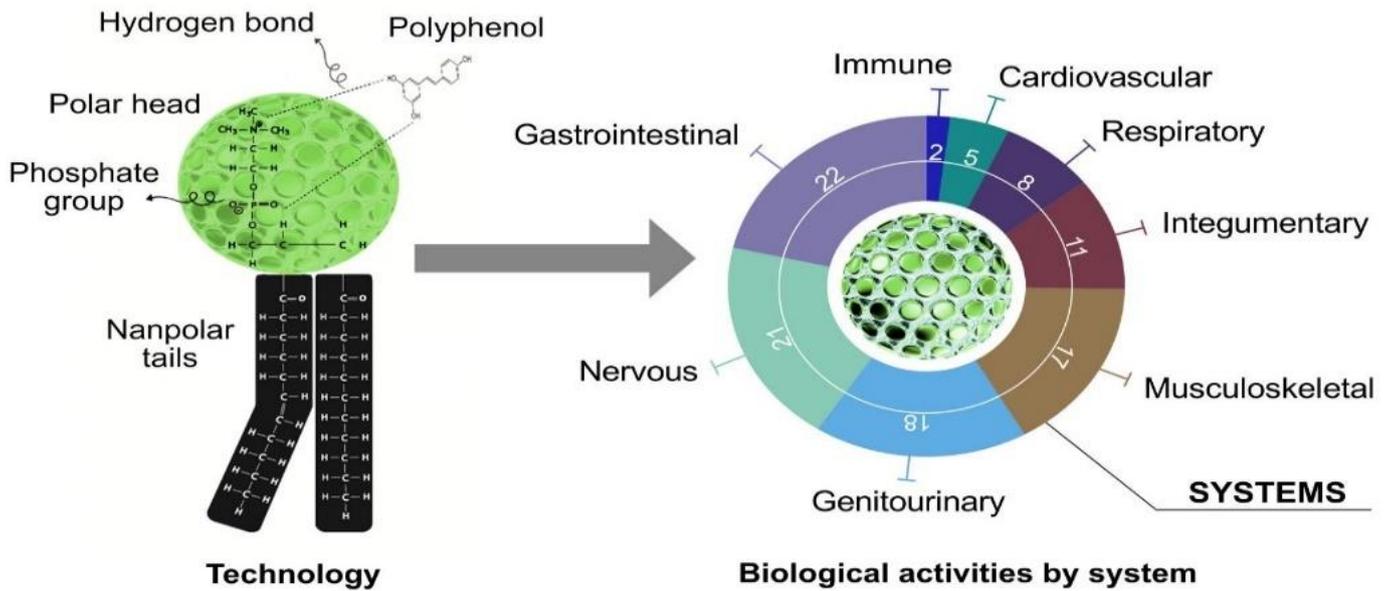


Fig no.3: Phytosomes

EMULSION : Emulsion is a non-homogeneous dispersion system made up of two different liquids that are unable to dissolve each other and disperse in the other in the form of droplets. Emulsions are made up of four components: oil, water, surfactant, and sub-surfactant. It has the appearance of a translucent to transparent liquid. Emulsions are classed as conventional (0.1-100 μm), micro-emulsion (10-100 nm), and sub-micro-emulsion (100-600 nm) (Table 4). Sub-micro-emulsions are called lipid emulsions, while micro-emulsions are also called nanoemulsions.

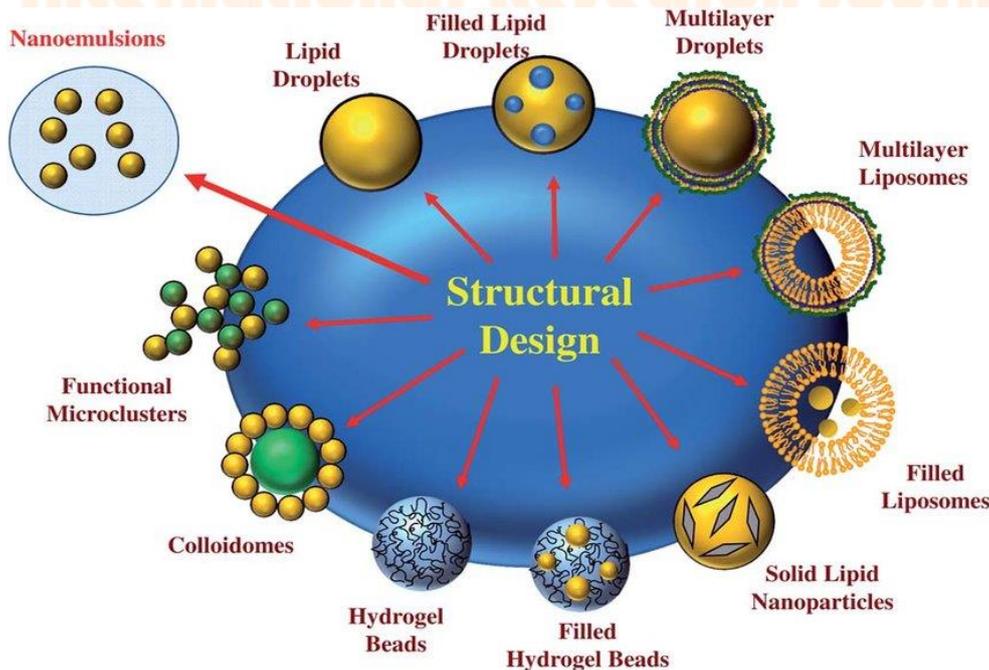


Fig no.4: Emulsion

DESIGNING AND DEVELOPMENT OF NOVEL DRUG DELIVERY SYSTEM

Researchers hope to improve the performance of intelligent drug delivery systems through design and development.²⁰The goal is to enhance therapeutic action while minimising unwanted side effects. This might be performed by modifying the independent factors, such as process or concentration, which could lead to escalating end-user difficulties. confidence. Each delivery mode has unique pharmacological and physiological features, so it is critical to consider independent variables while developing the final product.²¹ Knowing the physical, chemical, and pharmacological qualities of each excipient is critical. Factors aimed in improving insulin delivery systems include oral administration, proteolysis, and physical stability under extreme biological conditions. Numerous independent factors, such as polymer/crosslinker concentration, sonication time, stirring speed, and cross-linking time, have been investigated in connection with the necessary response.²² Also, when taken orally, the natural structures of proteins and peptides, such glucagon-like peptide 1 (GLP-1) and GLP-1 receptor agonists (GLP1RAs), alter, changing their surface.

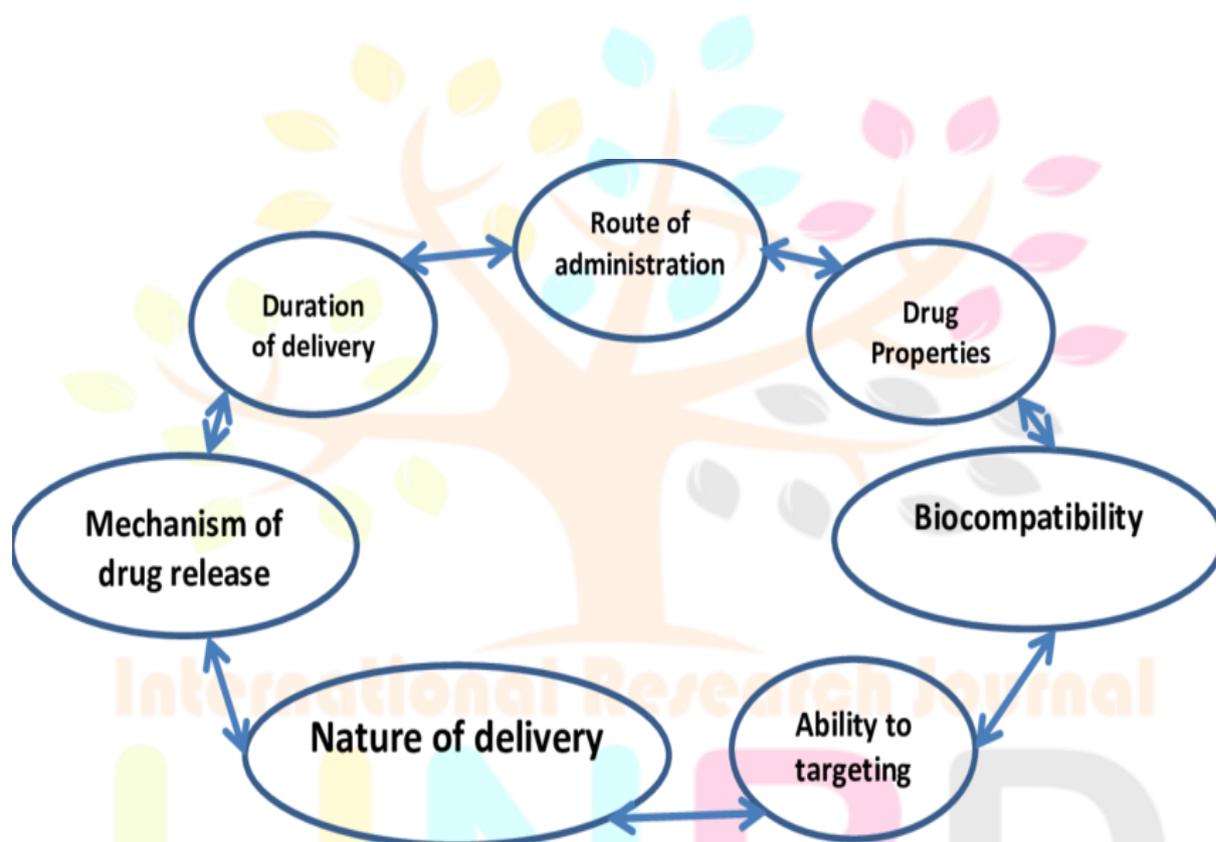


Fig no.5: Mechanism of designing and development of NDDS

❖ Route of administration

- A medication administration technique is typically defined by the site at which the drug is taken, such as oral or intravenous.²³ The routes used to administer medications are determined by the pharmacokinetics and characteristics of the substance in addition to convenience.

❖ Drug property

- Drug properties refer to a compound's structural, Biochemical, physicochemical, pharmacokinetic, and toxicological features. Some drug qualities are more useful for developing new medications.²⁴ These factors can influence a drug's oral bioavailability, metabolism, clearance, toxicity, and in vitro pharmacology.

❖ **Biocompatibility**

- Biocompatibility refers to a material's ability to interact with living tissue in a certain manner while generating minimal negative consequences include rejection or inflammation.²⁵
- It is a required prerequisite for dealing with any foreign thing that enters the human body, such as a medical device, prosthetic, or biomaterial.

❖ **Ability to targeting**

- Targeting is the process of selecting a certain group of people to receive marketing messages. It enables marketers to deliver more relevant, customised, and effective marketing communications to their intended audience.

❖ **Nature of delivery**

- Natural childbirth, also known as natural delivery, is a method of giving birth that minimizes medical intervention, especially anesthesia.²⁶ It can take place at home, a hospital, or a birthing center, and it can involve techniques like relaxation, controlled breathing, and emotional support to help ease pain. Other methods include.

❖ **Mechanism of drug release**

- Drug delivery refers to the principles of sustained and regulated release in terms of medicinal compounds.²⁷ It is released over a set period of time, with or without electrical stimulation. The three major modes of drug distribution are diffusion, erosion, and swelling.

❖ **Duration of delivery**

The delivery time refers to the day and time at which goods or services will be delivered.²⁸ It can also have to do with how long it takes for things that have been purchased to get to their destination. For example, if a delivery period is specified as 24 hours, an order must be submitted before a given day to ensure delivery.

Mechanism:

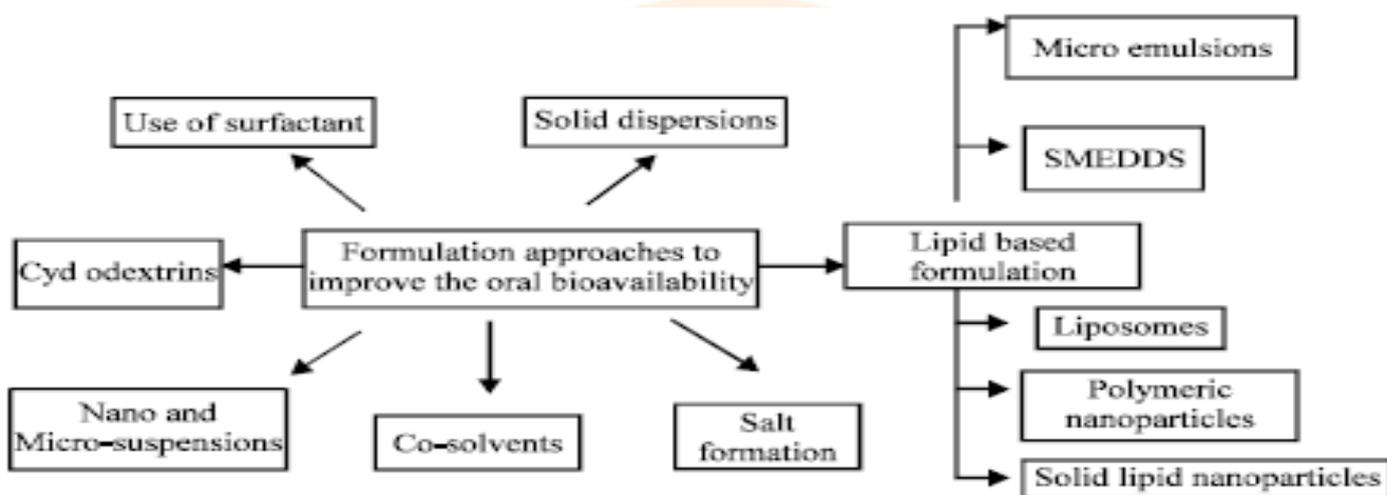


Fig. no. 6 : mechanism of novel drug delivery system

Advantage:

- ❖ **Improved Bioavailability;** NDDS can increase a drug's bioavailability by optimizing their absorption and reducing degradation in the gastrointestinal tract or first-pass metabolism.
- ❖ **Targeted Delivery:** These systems can deliver drugs specifically to the target site, reducing side effects and improving therapeutic efficacy.²⁹ For instance, drug delivery systems can target specific tissues, cells, or organs

- ❖ **Improved Bioavailability:** Advanced delivery technologies can improve the drugs' solubility and absorption that would otherwise be poorly bioavailable.³⁰This is especially beneficial for medications with low oral bioavailability.
- ❖ **Reduced Toxicity:** By targeting medications to specific cells or tissues, innovative metals can limit systemic exposure and, Consequently, the possibility of adverse effects.
- ❖ **Minimised Drug deterioration:** Some delivery systems shield pharmaceuticals from deterioration caused by environmental variables such as light, oxygen, or pH changes, extending the drug's stability and effectiveness.

Disadvantage

- ❖ **Complexity:** noble drug delivery systems can be quite complicated in both design and manufacture.³¹This complexity can cause problems in production scaling, and quality control.
- ❖ **Regulatory Challenges:** These systems are frequently subjected to severe scrutiny by regulatory agencies. The approval procedure can be time-consuming and expensive, potentially delaying the release of innovative medications
- ❖ **Uncertain Long-Term impacts:** The long-term impacts and potential dangers of new delivery systems may not be completely recognised when they are introduced.³²This ambiguity can jeopardise patient safety.
- ❖ **Limited Clinical Experience:** New delivery systems may have clinical experience compared to traditional methods. This can make it difficult for healthcare providers to predict how they will limited perform in real-world settings.

Scope:

- ❖ **Targeted Delivery:** Novel technologies seek to deliver medications directly to the target place of action, reducing adverse effects and increasing efficacy.³³ This includes targeted cancer therapy, in which pharmaceuticals are carefully focused at tumour cells, as well as targeted delivery for neurological illnesses, in which drugs are delivered to specific brain regions.
- ❖ **Controlled Release:** These systems regulate drug release rates to keep them at ideal therapeutic levels for long periods of time. This can help to minimise dose frequency while also improving patient compliance.³⁴ Extended-release tablets and implants are two examples of medication that is released gradually.
- ❖ **Nanotechnology:** Drug delivery using nanoparticles allows for precise dispersion and regulated release. Nanoparticles can increase the solubility of poorly soluble medications, improve stability, and allow them to traverse biological barriers such as the blood-brain barrier
- ❖ **Gene and RNA Delivery:** Systems for gene therapy or RNA-based therapeutics (such as mRNA vaccinations) are a rapidly expanding subject.³⁵They want to introducgenetic material into cells in order to treat or prevent diseases by changing gene exprssion
- ❖ **Smart Delivery Systems:** These systems use certain physiological variables to release the medicine. Examples include systems that release medication in reaction to pH or temperature changes, as well as those that use external triggers such as ultrasonic or magnetic fields.
- ❖ **Personalised Sustained and Prolonged administration:** Creating methods for sustained or prolonged drug administration can help patients adhere to their medications and eliminate the need for frequent dosage.³⁶ This includes long-acting injectable formulations and implants.
- ❖ **Biologics and Protein Delivery:** New systems are being created to transport large, complicated biologic medications and proteins, which frequently necessitate specialised delivery mechanisms due to their size and sensitivity.³⁷This comprises new formulations and delivery systems for monoclonal antibodies, vaccinations, and hormones.

Future and Prospective

1. Targeted Delivery

- ❖ **Specificity:** Drugs are delivered directly to specified cells or tissues, minimising off-target effects.
- ❖ **Example:** include liposomal formulations for cancer treatment and targeted nanoparticles.

2. Controlled Release

- ❖ **Sustained Release:** Drugs are released over time to maintain therapeutic levels while reducing dose frequency.³⁸
- ❖ **Pulsatile release:** Drugs are released at predetermined intervals or in reaction to physiological stimuli.
- ❖ **Examples:** include extended-release pills and biodegradable implants.

3. Improved Bioavailability

- ❖ **Enhanced Absorption:** Improves the absorption of medications that are poorly soluble or have low bioavailability.³⁹
- ❖ **Examples;** include nanoparticle formulations and cyclodextrin complexes.
 1. **Non- Invasive Administration**
 - ❖ **Ease of Use:** Provides different routes of delivery that do not require injection.
 - ❖ **Examples:** include transdermal patches and oral dissolvable films.
 2. **Biocompatibility and safety**
 - ❖ **Reduced Toxicity:** is reduced by using materials that are compatible with biological systems and cause less unpleasant effects.
 - ❖ **Examples;** include biodegradable polymers and natural materials.
 3. **Smart and Responsive system**
 - ❖ **Stimulus-Responsive:** Drugs are released in reaction to certain physiological or environmental events.
 - ❖ **Examples:** include pH-sensitive nanoparticles and temperature-sensitive hydrogels.
 4. **Personalization**
 - ❖ **Customisable distribution:** Drug distribution is tailored to individual patient needs based on genetic, physiological, or disease-specific characteristics.
 - ❖ **Example:** personalised cancer vaccinations and dosing regimes.⁴⁰

Conclusion:

Using plant extracts and active components to target and deliver novel medications is the subject of extensive research. Nevertheless, this field of study is still in its experimental phase. Numerous problems with application, production, and research. must be fixed. To reduce drug toxicity and increase activity, more research on carrier materials is required. Due to their low lipid content, herbal drugs have a great deal of therapeutic potential. Incorrect molecule size, solubility, or both, resulting in limited bioavailability and inadequate absorption. Because they contain polar phytoconstituents like flavonoids, terpenoids, tannins, and xanthenes, standardised plant extracts are delivered by novel drug delivery systems. These extracts have a much better absorption profile, which enables them to cross the cellular membrane and increase bioavailability. ought to be looked into with the use of certain valuable medicine delivery technology. The main obstacles to drug absorption following oral or topical administration are lipid solubility and molecular size. Different plant extracts Phytomolecules high.

Acknowledgement:.

Novel drug delivery systems (NDDS) represent a noteworthy development in pharmaceutical research that provides novel ways to improve the safety and effectiveness of medicinal medicines. These systems are intended to minimise negative effects and maximise therapeutic advantages by optimising drug release, enhancing bioavailability, and facilitating targeted delivery to certain tissues or cells. NDDS enable regulated release mechanisms that can adjust to the body's physiological conditions by utilising state-of-the-art technologies like nanotechnology and stimuli-responsive materials. In fields like cancer treatment, where focused treatments can specifically target tumour cells while preserving healthy tissues, this strategy is especially revolutionary. Furthermore, NDDS could transform the way gene treatments and biologics are delivered, thereby increasing the range of uses for these technology.

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