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Nanostructured drug delivery systems: An alternative approach to herbal medicine

Srushti Dinesh Bargude [1,*], Gitanjali Lalasaheb Chopade [1], Amit Vilas Pondkule [1], Sudarshan Narayan Nagrale [2] and Vishal Bharat Babar [2]

[1] *Department of Pharmaceutics, Dattakala Collage of Pharmacy, Swami-Chincholi, Daund, Pune, Maharashtra, India-413130.*
[2] *Department of Pharmaceutical chemistry, Dattakala Collage of Pharmacy, Swami-Chincholi, Daund, Pune, Maharashtra, India-413130.*

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Abstract

Medical professionals and patients alike are aware of the advantages of using medicinal plants, which have been utilised for centuries. Due to their superior therapeutic qualities because they are less likely to have side effects than current medications, the herbal treatment contributes to an improvement in therapeutic value. Nanostructured formulations are used to make herbal medicines more soluble and to help localize the medicine in a particular place, improving its efficacy and safety. Polymeric nanoparticles are colloidal structures that function as drug release control and localization vectors. They can be used to reduce the toxicity and side effects of pharmaceuticals while also increasing bioavailability. In this paper, we will discuss the advantages and disadvantages of nanostructured drug delivery systems.

Keywords: Herbal Medicine; Novel Drug Delivery System; Bioavailability; Efficacy; Nanoparticle

1. Introduction

Herbal treatments have been used extensively throughout history, and both patients and medical professionals are aware of their advantages.For their superior therapeutic qualities because they are less likely to have side effects than current medications[1].Due to their potential to have significant positive effects on society or even all of humanity, medicinal plants are receiving more attention than ever. This is especially true in the field of medicine. By decreasing the toxicity and side effects of pharmaceuticals while also increasing bioavailability, the herbal treatment contributes to an improvement in therapeutic value[2].More than two thirds of all plant species in the world are found in developing nations, at least 35,000 of which are thought to have medicinal value. The current pharmacopoeia contains at least 7,000 medical substances that are derived from plants[3].Significant differences in plant features have been found in many medicinal and aromatic plants (MAPs) with different soil traits, and it has been shown that specific elements can be selectively recovered and then released in food. To achieve sufficient yields of high-quality and competitively priced goods while maintaining their safety and nutritional content, great care must be taken while selecting the soil and cropping systems[4].

2. Novel drug delivery system

Polymeric nanoparticles are colloidal structures that function as drug release control and localization vectors. Polymeric nanoparticles have advantages over conventional formulations in that they can make ingredients more soluble, lower the therapeutic dose, and enhance active ingredient absorption. Nanoparticles are also advantageous when used in

*Corresponding author: Bargude Srushti Dinesh

blood since they are stable,non-poisonous, anticoagulant, non-immunogenic, anti-inflammatory, do not activate neutrophils, do not interact with the reticuloendothelial system, nanoparticles are also advantageous when utilized in blood. Sometimes, polymeric nanoparticles are used as a cell surface or to access particular tissues[5]. Various techniques can be used to create polymeric nanoparticles, depending on their payload and intended application. These particles are created from polymers that can degrade naturally or artificially. Natural materials are favored because they typically offer additional benefits, including the capacity to deliver several active ingredients using the same carrier, lengthen the amount of time they spend inside the body, offer a sustained release method, and minimize negative effects[6].

Advantages of NDDS

- They appear to be able to deliver high drug concentrations to disease areas due to their unique shape and large loading capacities.
- By delivering the medication in tiny particles, you can increase the drug's surface area and hasten blood clotting[7].
- At the locations, the concentration appears to last for longer times. Demonstrates the EPR (increased permeation and retention) effect, which refers to improved penetration across barriers due to the tiny size and retention due to inadequate lymphatic outflow, such as in tumors.
- The disease site of action is passively targeted without the use of a particular ligand moiety.
- Reduced dosage of the medicinal formulation; less side effects[8].

3. Herbal Medicine for Nano formulations

Pharmaceutical organisations find it exceedingly difficult to develop a complete herbal medication since a variety of elements impact the biological efficiency of plant herbal medicine and the repeatability of its therapeutic potential. Asthma, pain, fever, and other issues can necessitate the need for medications to work fast in some situations, while chronic conditions like cancer, diabetes, and hypertension may necessitate therapies with a longer half-life. Herbal medicine is strictly forbidden in both stages due to its physical and chemical characteristics.

Their influence on contemporary medical practice has surely lessened as a result of these circumstances. A lot of money has been spent on research in recent years to produce successful herbal medicine products. But nanotechnology approaches are required to achieve the requisite efficacy[9].

Nanogels are contemporary pharmaceuticals dosage form that require special consideration due to their great colloidal stability, strong cell internalization capabilities, controlled drug administration, affinity for aqueous solutions, and tendency to remain inert in the blood. Nanogels can also readily overcome the difficulties that currently face herbal compositions[10].

4. Need of the nanoparticles in herbal remedies

For the following reason, herbal nanoparticles were selected to address the drawbacks of conventional herbal remedies: [11]

- Targeting herbal medicines to specific site with nanoparticles increases selectivity, medication delivery, potency, and safety.
- Nanoparticles can be used to make herbal drugs more soluble and to help localize the medicine in a particular place, improving its efficacy.
- Nanoparticles can deliver large quantities of medications to illness sites because of their unique size and high loading capacities.
- Giving the medication in little particles increases its surface area overall, hastening its absorption into the circulation.
- Demonstrates greater penetration over barriers due to compact size and retention because of insufficient lymphatic drainage, among other improved permeation and retention benefits[12].
- Without the need of a specific ligand moiety, it demonstrates passive targeting to the disease site of action and reduces adverse effects.

Liposomes appear to be the most promising of the aforesaid delivery systems, not only because of their efficacy in encapsulating hydrophilic, amphiphilic, and hydrophobic medicines, but also because of their biocompatibility, biodegradability, and drug loading efficiency[13].

5. Herbal Nanoparticle Formulations

Some of the formulations of herbal nanoparticles are listed below;

Table 1 Herbal Nanoparticle formulations

Sr. No	Formulations	Active ingredients	Applications	Biological activity	Method of Preparation	Route of administration
1	Cuscuta [14]	Flavonids, Lignans	Increase water solubility	Antioxidant, Hepatoprotective	Nanosuspension technology	Oral
2	Artemisinin [15]	Artemisinin	Sustained release medication	Anticancer	Self-Assembly Procedure	Intravenous
3	Radix Salvia mitiorrhiza [16]	R. salvia miltiorrhiza	Used in cardiovascular disease	Antioxidant	Spray-drying Process	Intravenous
4	Berberine-loaded nanoparticles [17]	Berberine	Sustained release medication	Anticancer	Solvent evaporation method	Intravenous
5	Paclitaxel-loaded nanoparticles [18]	Taxel	Increase bioavailability	Anticancer	Solvent evaporation method	Intravenous
6	Quercitrin Nanoparticles [19]	Quercitrin	Intestinal antiinflammatory	Antioxidant	Solvent evaporation method	Oral
7	Hypocrellin nanoparticles [20]	Hypocrellins	Improved stability and hydrophilicity	Antiviral	Solvent evaporation method	Oral
8	Silybin lipid Carriers [21]	Silybin	Sustained release	Antihepatoxic	Solvent evaporation method	Subcutaneous
9	Ginseng Capped Gold Nanoparticles [22]	Ginseng	Used in stability enhancer	Antioxidant	Ultra-sonication	Oral

6. Conclusion

The bulkiness of herbal medicines inhibits their bioavailability and potency. Herbal medications with nanostructures improve on the drawbacks of traditional delivery methods. Additionally, they lower the price of productivity, drug toxicity and restrictions, etc. Two innovative approaches to the future of pharmaceutics are nanoparticles and herbal medications. At an industrial level, the practise of adding NDDS for herbal medications has also become popular.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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