



ORIGINAL RESEARCH PAPER

Clinical Biochemistry

NANOTECHNOLOGY FOR HERBAL DRUGS AND PLANT RESEARCH ADVANCEMENTS IN HERBAL TREATMENT: A REVIEW

KEY WORDS:
Nanotechnology, Herbal remedies, Formulation techniques of nanoparticles, Standardization of herbal drugs.

Dr. Prathiba H. D.*

Department of Biochemistry, Jnanabharathi Campus, Bangalore University. Bengaluru, Karnataka, India. *Corresponding Author

ABSTRACT

Herbal medications have been used all over the world from last many years. Especially in India, there is wide market for herbals. Herbal medicines have less adversative effects as compared with modern medicines. The distribution of plant/herbal therapeutic molecules as drugs is challenging due to poor solubility, poor permeability, low bioavailability, instability in biological milieu and extensive first pass metabolism. Nanotechnology is an opening up for new perspectives in all scientific and technological fields. Among these applications, herbal drugs and nutraceuticals are the fast developing fields in nanoresearch. These restrictions of herbal drugs can be overcome by capturing them with suitable nanomaterials. A variety of new herbal preparations and nutraceuticals like polymeric nanoparticles, nanocapsules, nanoemulsions, transferosomes and ethosomes has been informed using bioactive, plant extracts and food materials. The new approach in herbals as nanotechnology have a sound forthcoming which has a scientific method to deliver the module in sustained manner which increase the patient agreement and avoid repeated direction. So many circumstances like bacterial infection, hepatotoxicity, inflammation, oxidation and chronic diseases like cancer, wound healing can be cured by nano herbals more effectively as compared to allopathic medicines. This review will provide information of the use of nanotechnology for herbal drugs, nanoparticles, formulation techniques of nanoparticles and their standardization.

INTRODUCTION

Nanotechnology is the new emerging skill in the drug innovation and it has the property of self-targeting in the sense that without the addition of a specific ligand, the nanoparticles can be recycled for targeting, due to their characteristically small size, at the infected pathological areas. Both developing and developed countries are concentrating on the approval of herbal drugs mainly due to their estimated origin and low side effect. Fast-growing nanotechnologies have provided strong support for emerging innovative novel herbal drugs. Nutraceuticals are foods and food ingredients that provide health benefits beyond basic nutrition, but many nutraceuticals show reduced bioavailability. Nanotechnology is an advanced scientific technique in the 21st century. By analysing the affiliation between nanotechnology and biological medication, the presentation of nanotechnological methods for bioavailability development of herbal drugs can be brought about. It is specified that nanotechnology is one of the wildest developmental, the most potential and the far-reaching high and new skill in the present period, and it greatly encourages the development of biological medicine and bioavailability enrichment of herbal drugs. With the application of nanotechnology of nanomization of herbal drugs, it will make the expansion of nanoherbal drugs keeping high bioavailability, which subsequently will open the new era of herbal drug discovery [2].

Herbal drugs have now occupied lead positions in the pharmacopoeia, and the improvement in this concern through nanoformulations using nanotechnology have been done. The nanomaterials can significantly enhance the pharmacokinetics and therapeutic index of plant drugs. Targeted delivery and combination therapy can drastically improve the performance of herbal drugs [5].

Nanotechnology In Herbal Drugs

Nanotechnology can be used to enhance delivery of poorly water soluble herbal drugs, targeted delivery in a cell or tissue, also some cross tight epithelial and endothelial barriers, release of large herbal molecules, co-delivery to two or more drugs and observation of sites of drug delivery by incorporating herbal drugs with imaging modalities [6-8]. Applications of nanotechnology formulated herbal drugs are schematically represented in Figure 2. Table 1 summarizes the various nanostructured herbal formulations, their different applications and biological activities.

delivery system than conventional forms of drugs. Nano carriers transdermal gel (NCTG) was formulated from optimized nanotransfersomes of diclofenac diethylamine (DDEA) and curcumin (CRM) for providing a sustained and targeted effect. Due to Nano particulate size of NCTG achieving higher absorption of the drug plus co-administration of lecithin; providing hydration gradient to the vesicles, increase permeability, decreased degradation and clearance by surfactant than that from marketed gel and plain curcumin gel was reported [9 pH-sensitive nanoparticles of curcumin-celecoxib combination were formulated as a potential therapy for uncreative colitis [11]. Curcuminloaded hydrogel nanoparticles of hydroxyl propyl methyl cellulose (HPMC) and polyvinyl pyrrolidone (PVP) were successfully formulated and exhibited a significant improvement in antimalarial action [3]. Biosynthesis of silver nanoparticles (AgNPs) were demonstrated by leaf extract of Mukia scabrella, it exhibited significant antimicrobial activity against MDR-GNB nosocomial pathogens [4].

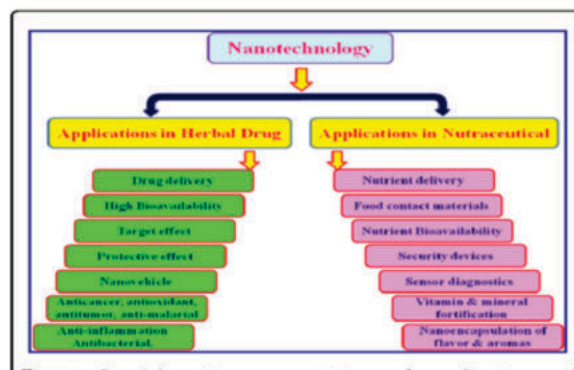


Figure 1: Schematic representation of applications of nanotechnology formulated herbal drugs and nutraceuticals.

Before reaching to the blood, many constituents of the herbal drugs will be smashed in the highly acidic pH of the stomach and other constituents are metabolized by the liver. It results; the optimum quantity of the herbal drugs may not reach the blood. If the drug does not reach in the optimum amount to the infected region at "minimum effective level," then there will be no means to show the therapeutic effect of the drug. Nanocarriers applying to herbal remedies will carry optimum amount of the drug to their site of action bypassing

all the barriers such as acidic pH of stomach, liver metabolism and increase the prolonged circulation of the drug into the blood due to their small size.

Herbal medications were selected for distribution through a nano delivery system because of the following assets:

1. Effective acetone, chloroform, petrol and methanolic extracts are existing which may not be suitable for delivery as such.
2. These are the bulk drugs so dose decrease is intended.
3. Presently marketed preparations lack target specificity for numerous chronic diseases.
4. Some other side effects are related with currently marketed formulations.
5. Patient non-compliance due to large quantities and less efficiency with the available formulations.

Benefits Of Herbal Nanoparticle Distribution System

1. Expressions EPR (enhanced permeation and retention) result i.e. enhanced permeation through the barriers because of the small size and maintenance due to poor lymphatic drainage such in tumor [8].
2. Shows passive pointing to the illness site of action without the accumulation of any particular ligand moiety.
3. Reduction in the side effects.
4. Decrease in the dose of the drug formulation.
5. Nanoparticulate scheme delivers the herbal invention directly to the site of action.
6. Improved efficacy and therapeutic index [10].

Types Of Nano Pharmaceuticals

- Polymeric nanoparticles.
- Solid lipid nanoparticles.
- Magnetic nanoparticles.
- Metal and inorganic nanoparticles.
- Colloidal nano-liposomes.
- Phospholipids micelles.
- Polymeric micelles.
- Nano crystals.
- Quantum dots.

Methods Which Are Used For The Preparation Of Above Nanopharmaceuticals:

1. Complex Coacervation Method:

This is a natural phase separation process of two liquid phases in colloidal systems, which results due to the interaction of two oppositely charged polyelectrolytes upon mixing in an aqueous solution.

It mainly includes three steps-

- 1 Development of three immiscible chemical phases.
- 2 Depositing the liquid polymer coating upon the core material.
- 3 Rigidizing the coating.

Co-precipitation Method:

This method is a alteration of the complex coacervation technique for the research of nano scale core-shell particles. This process has been reported to provide good dispersion stability to poorly water-soluble drugs [8,11].



Figure 2: Co-precipitation Method

Nanoprecipitation Method Or Solvent Displacement Method:

As biodegradable nanoparticles meet with increasing interest for drug delivery applications, a series of investigations were carried out to understand the mechanism of the formation of drug loaded nanoparticles using the solvent displacement method. This method is based on interfacial deposition of a polymer after displacement of a semipolar solvent miscible with water from a lipophilic solution, thereby resulting in a decrease in the interfacial tension between the two phases, which increases the surface area with a subsequent formation of small droplets of organic solvent even without any mechanical stirring [09].

Solvent Emulsification-diffusion Method:

This process involves preparation of an o/w emulsion using oil phase having polymer like PLGA and oil in an organic solvent which is emulsified with the aqueous phase having stabilizer in high shear mixer followed by addition of water to induce the diffusion of organic solvent, thus resulting in formation of nanoparticles [11].

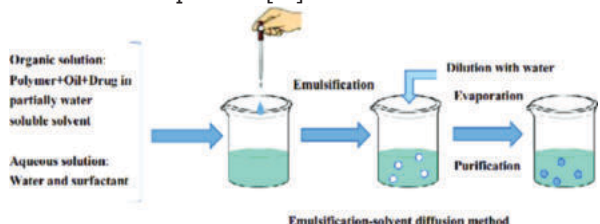


Figure 3: Solvent Emulsification Solvent Diffusion Method

Progressive Techniques For Documentation And Characterization Of Nano Herbal Medicine:

High Performance Liquid Chromatography (HPLC):

Preparative and analytical HPLC are widely used in pharmaceutical industry for isolating and purification of herbal compounds [9]. Vasicine, the major bioactive alkaloid of *Adhatoda vasica*, was estimated by HPLC in two polyherbal drug formulations - *Shereeshadi Kashaya* and *Yastyadivati*, and its content was found to be 18.1 mg/100 g in *Shereeshadi Kashaya* and 0.7 mg/100g in *Yastyadivati* [4]. mixture of *Emblica officinalis*, *Terminalia chebula* and *Terminalia bellerica* in equal proportions has been reported by HPLC method by using the RP18 column with an acidic mobile phase [10].

The combination of HPLC and LC/MS is currently the most powerful technique for the quality control of herbal medicine like licorice [3].

High Performance Thin Layer Chromatography (HPTLC):

HPTLC is used for quantitative and qualitative phytochemical investigation of herbal drugs and preparations. Also with the assistance of HPTLC several samples can be analysed concurrently using a small capacity of mobile phase. Gallic acid, rutin and quercetin these are important active constituents of *Terminalia chebula* were estimated by HPTLC method [11].

HPTLC technique was used for simultaneous determination of two biomarkers present in *Ashwagandha* like Withaferin A and β sitosterol d-glucoside. Glycoside (jamboline), Tannin, Ellagic Acid and Gallic Acid are present in mother tincture of *Syzygium jambolanum* was quantitatively evaluated in terms of stability, repeatability, accuracy and calibration by HPTLC.

The HPTLC technique gives accurate, faster and cost current measureable control for the analysis of dysgenic.

UPLC:

Ultra performance liquid chromatography (UPLC) was used to evaluate decocting-induced chemical revolutions and chemical reliability between traditional and dispensing granule decoctions.

Table 1: Herbal Drug Nanoparticles

Sr. No.	Formulations	Active Ingredients	Biological activity	Method Of Preparation	Benefit Of Formulation	References
1.	Berberine-loaded nanoparticles	Berberine	Anti-neoplastic activity	Ionic gelation method.	H.pylori growth inhibition	2,40
2.	Curcuminoids solid lipid nanoparticles	Curcuminoids	Antitumor, antioxidant, antiamyloidin, antiplatelet aggregation and anti-inflammatory, antimalarial.	Micro-emulsion technique.	-increase in activity -Enhanced stability of curcuminoids	40,
3.	Artemisinin nanocapsules	Artemisinin	Anticancer	Self assembly procedure.	- achieving prolonged drug release through self-assembly of polyelectroytes on natural drug crystals. - controlled release	9,40,
4.	Nanoparticles of cuscuta chinensis	Flavonoids and lignans	-Hepatoprotective and antioxidant effects -Used to improve sexual function, prevent senescence and regulate the immune system. Some studies showed anticancer, antiageing and immune-stimulatory effects. ⁴⁶⁻⁵⁰	Nanosuspension method.	Enhanced solubility	41

Standardization Of Nano Herbal Medicine:

CONCLUSION

Nanotechnology has the property of self-targeting in the sense that without the attachment of a specific ligand, the nanoparticles can be used for targeting, due to their distinctively small size, at the infected pathological areas. Treatment of chronic diseases like cancer using targeted drug delivery nanoparticles is the latest achievement of nanotechnology. By analyzing the relationship between nanotechnology and biological medicine, the application of nanotechnological methods for bioavailability enhancement of herbal drugs can be brought about. With the application of nanotechnology of nanomization of herbal drugs, it will make the development of nanoherbal drugs possessing high bioavaibility, which consequently will open the new era of herbal drug discovery. At present, several nano drugs are under investigation for drug delivery and more specifically for cancer therapy.

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