



INTERNATIONAL JOURNAL OF PHARMACY AND ANALYTICAL RESEARCH

ISSN:2320-2831

IJP AR | Vol.8 | Issue 4 | Oct - Dec - 2019
Journal Home page: www.ijpar.com

Review article

Open Access

Nanoparticles drug delivery system in herbal medicines - a review

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ABSTRACT

Herbal medicines are preferred over modern medicines by physicians to the patients for its therapeutic efficacy and minimal adverse effects and cost effectiveness. Herbal medicines are used from ancient times for its therapeutic value. Though we have achieved more in treating ailments by using modern medicines, herbal medicines are tend to possess significant role in the treatment and prevention of diseases. Not only for medicines can herbs be used in cosmetics. Novel drug delivery system plays a vital role in using herbal medicines in the form of nano herbal formulation. Herbal medicines show the results only after usage for longer period but that can be overcome through nano herbal formulation, which provides reduced toxicity along with better bioavailability. This article has explained the herbal nano medicine and its advantages, history and development of herbal nano medicines, applications in nanotechnology and nutraceuticals, types of nanoparticles and strategy of nanotechnology in novel drug delivery system.

Keywords: Herbal medicines, Nanotechnology, Toxicity, Bioavailability, Nanoparticles drug delivery system and Application of nanotechnology.

INTRODUCTION

Ayurveda is unique of the earliest therapeutic sciences experienced in India [1]. Later olden time, natural products and herbal therapies are being used to cure the viruses. Distinct extensively used allopathic scheme, the herbal therapies have thousands of constituents that all work concurrently against the diseases [2]. Herbal medicines have

remained standard by surgeons to the patients outstanding to their potential therapeutic effect and also their minimal side possessions as associated to other medicines [3, 4]. Herbal medicine is similarly named botanic drug or phytomedicine. It is discussing towards using an herb's seeds, berries, origins, leaves, flowers or bark for therapeutic determinations. An herb is a plant or plant fragment used for its odor, flavor, or therapeutic properties.

Phototherapeutics' wants a technical method to distribute the mechanisms in a continued manner to increase avoid frequent administration and patient acquiescence. This can be attained via scheming Novel Drug Delivery Systems (NDDSs) for herbal citizens. NDDS not individual decrease the frequently direction to speechless noncompliance, then similarly support towards rise the therapeutic value through increasing the bioavailability and reducing noxiousness [5, 6]. Combination of the herbal extracts/ constituents addicted to fresh formulation schemes have certain further advantages, such as their bulk medicating and less absorption can remain speechless which is the main problematic actually faced, attractive the attention of most important pharmacological companies. The movement of herbal remedies hangs on overall function of a variability of energetic components, as all the constituents offer synergistic act and thus improve the therapeutic rate. Nano carriers put on to herbal therapies will convey best quantity of the medicine to their site of action avoiding all the barriers such as acidic pH of gastrointestinal, liver metabolism and rise the continued passage of the medicine into the blood due to their minor size [7-11]. Integration of the Nano carriers as a NDDS in the traditional remedy system is crucial to struggle more long-lasting diseases like cancer, diabetes, asthma, and others.

HISTORY AND DEVELOPMENT OF HERBAL DRUGS

In the meantime, prehistoric times, natural products, as well as plants, have remained the source of treatment of human illnesses. The origin of idea of recent medicine development remains fixed in traditional remedy and treatments [12]. For an extended period, herbal medications remained not measured designed for growth as different preparations due to absence of technical validation and dispensation complications, such as extraction,

standardization, and of specific drug components in complex poly-herbal systems [13, 14].

Herbal medications were selected as possible drug applicant for distribution over a nano transfer system for the reason that of the following assets:

- Patient non-compliance due to bulky prescriptions and a reduced amount of effectiveness with the existing preparations.
- Active chloroform, acetone, petrol and methanolic extracts are existing which might not be apt for transfer as such.
- These remain the bulk medications so quantity reduction is proposed.

NANOTECHNOLOGY

The term nanotechnology was derived from Greek word 'nanos', it means dwarf. It is the new technology in medicine finding and it has property of self-targeting. Nanotechnology is a progressive technical system in 21st century. Herbal drugs have been extensively used worldwide in the meantime earliest periods and have been predictable by doctors to the patients aimed at their improved beneficial values as per they have rarer adverse effects as related to recent medications. The size of particle is less than 100 nm [15].

Nanotechnology has plays an significant role in the following fields

Applications of herbal drugs

Applications of herbal drugs in various fields such as drug delivery shown in Figure 1, high bioavailability, target effect, protective effect, nano vehicle, anti-cancer, antioxidant and anti-inflammation etc.,

Applications in nutraceuticals

Nutraceuticals has utilized in the fields such as nutrient delivery, nano capsulation, nutrient bioavailability, Nano precipitation, sensor diagnostics, vitamins and mineral fortifications, Nano encapsulation of flavor and aromas.

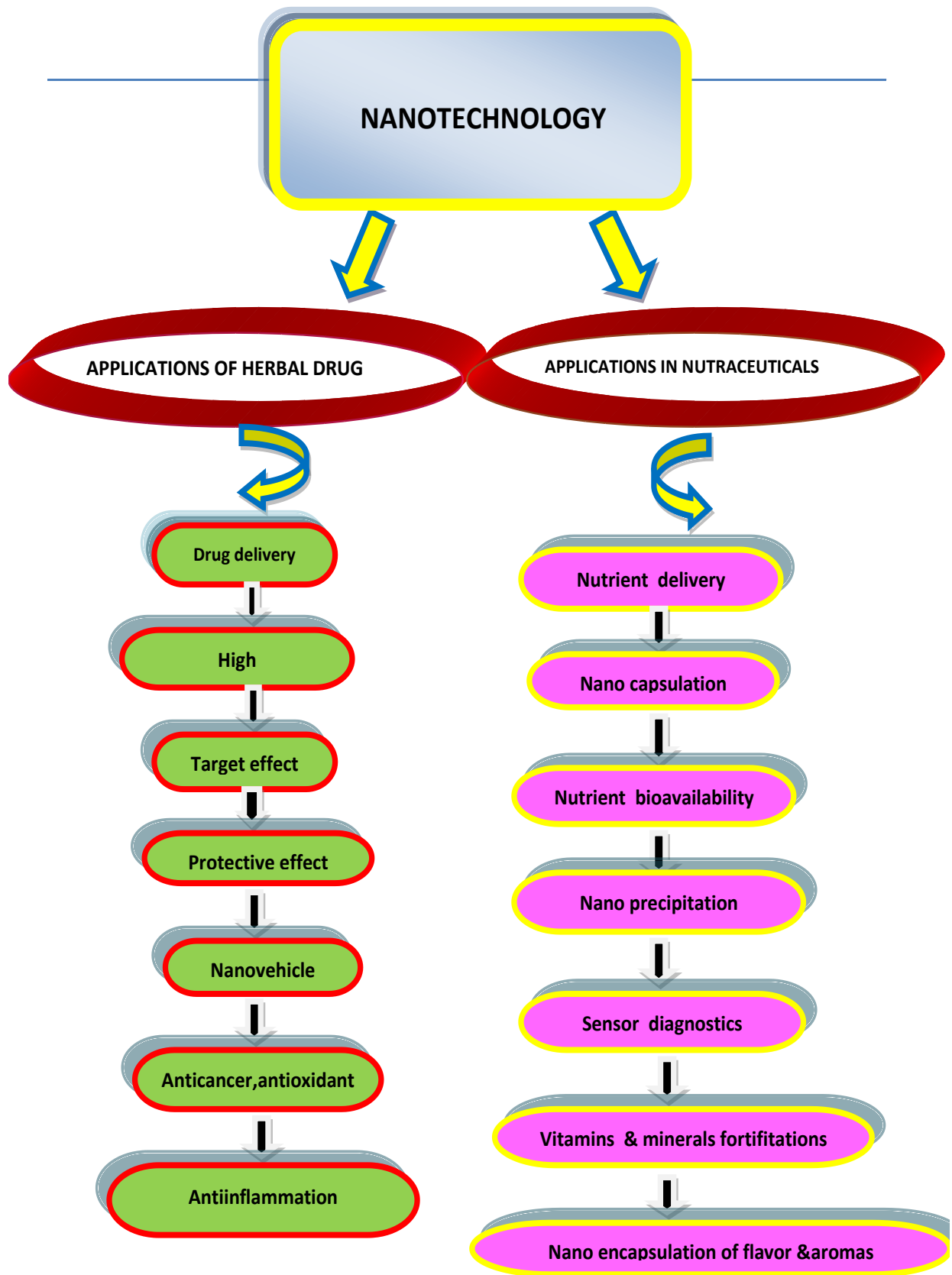


Figure 1: Application of Nanotechnology

Strategies of nanotechnology as novel drug delivery system

Medicine transfer system fetched a NDDS, a novel approach towards overcome the disadvantages of the out-of-date drug delivery systems.

Nano-sized distribution scheme was preferred as of the following reasons:

- Decline in the side effects.
- Exhibits inert pointing to the disease site of action without the count of any specific ligand moiety.
- They look to be able to distribute high attentions of medications to disease sites because of their unique size and high loading capacities.
- Shows EPR (enhanced permeation and retention) effect, i.e., enhanced infusion over the barriers because of the minor size and retention due to poor lymphatic drainage such in cancer.
- Advances in nanotechnology lead to a rise in potential therapeutic strategies against AD progression.
- The concentration appears to continue at the positions for the extended phases.
- Deliver the medicine in the small particle size that improves the whole superficial area of the drugs allotting quicker dissolution in the blood.
- Reduction in the dosage of the medicine formulation.

Approaches of nanotechnology

- In recent time, the nano ionization of herbal medicines has attracted abundant attention [17].
- Here are nearly approaches are used to formulate nano formulation like Nanoparticles, Nanoemulsions and Liposome etc., are colloidal systems through particles varying in size from 10 nm to 1000 nm [18 & 19]. Nanoparticle systems with mean particle size well above the 100 nm standard also remained stated in literature including nanosized curcuminoids [20 - 22].

NEED FOR NANO-SIZED DELIVERY SYSTEM FOR HERBAL REMEDIES

Nano-sized herbal dispersal system has selected to overcome the disadvantages of the traditional herbal drug delivery systems because of the following reasons:

- Nanoparticle can be used to target the herbal medicine to specific organ that advances the selectivity, drug delivery, usefulness and protection and thereby reduces dose and increases patient compliance.
- Nanoparticles can be used to rise the herbal drug solubility and assistance to localize the drug in a definite site thus resulting in improved efficacy.
- Nanostructure lipid carriers (NLCs) improve the efficiency of encapsulation and minimize the expulsion of active particles during encapsulation.
- The improved infusion and maintenance of nanoparticles can cross the Blood Brain Barrier (BBB).
- Nanoparticle can be used to target the herbal drugs to specific tissue that advances the selectivity, solubility, drug distribution, safety, effectiveness and reduces the normal dose.
- Decrease in noxiousness, whereas maintaining therapeutic effects.
- The nanoparticle drug distribution improves the whole surface area of the drugs thus allocating more rapidly dissolution in the blood.
- Exhibits inactive pointing to the disease place of action without the addition of any particular ligand moiety.

NANOPARTICLES

In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Nanoparticles are particles between 1 and 1000 nanometers in size. Particles are further classified according to diameter [16].

Role of nanoparticles

- Decreased fed/fasted variability.
- Combined therapy of the two different modalities or drugs.
- More rapid onset of therapeutic action.
- Drug transfer system is targeted in a specific manner.
- Increased oral bioavailability.

Properties of nanoparticles

- They remain effectively a bond among bulk materials and atomic or molecular structures.

- The high surface range to capacity ratio of nanoparticles provides a marvelous driving force for diffusion, particularly at prominent temperatures. Sintering can take place at lesser temperatures, over shorter time scales than for larger particles.
- Suspensions of nanoparticles are probable then the interaction of the particle surface with the solvent is strong sufficient to overcome density alterations, which otherwise generally result in a substance moreover sinking or hanging in a liquid.
- Nanoparticles similarly often possess sudden visual properties, as they are small sufficient to impound their electrons and create significant effects. For example, golden nanoparticles look profound red to black in solution.
- Nanoparticles by one-half hydrophilic and the other half-hydrophobic are called Janus particles and are predominantly useful for emulsions. They can self-assemble at oil /water interfaces and act as solid surfactants.

- The photocatalytic action of the nanoparticles must not guide to a self-destruction of the composite structure and it is important to ensure this point before fixing a grouping of nanoparticles and polymer matrix [34].

Advantages of nanoparticles

Significant advantages of Nanoparticles are given below:

- Decrease in fed or fast variability
- Increase bioavailability
- Smaller dosage form
- Less toxicity
- Dose proportionality.

Types of nanoparticles

Here are two types of nanoparticles and they are organic and inorganic.

Inorganic nanoparticles

The several types of inorganic particles shown in Table 1 namely magnetic, metallic, ceramic and nanoshells.

Table 1: Classification of Inorganic Nanoparticles with various particle size

INORGANIC COMPOUND	SIZE RANGE (nm)	DESCRIPTION
Metallic	<50	Gold and silver particles
Magnetic	5-100	Super paramagnetic iron oxide particles
Nanoshells	10-300	Dielectric silica core in a thin gold metal shell
Ceramics	<100	Inorganic porous bio

Organic nanoparticles

The diverse types of organic nanoparticles shown in Table 2 namely carbon nanotubes quantum dots, dendrimers, liposome and polymers.

Table 2: Classification of Organic Nanoparticles with various particle size

ORGANIC COMPOUND	SIZE RANGE (nm)	DESCRIPTION
Carbon tubes	1.5-5000	Cylindrical graphite sheets
Quantum dots	<10	Semiconductor rock crystal with a cadmium core and metal shell
Dendrimers	5-20	Highly branched macromolecules
Liposomes	5-100	Phospholipids
Polymers	10-1000	Colloidal particles

OTHER TYPES OF NANOPARTICLES

Labile Nanoparticles

Liposomes, micelles, polymers, nanoemulsions etc.

Insoluble Nanoparticles

TiO₂, SiO₂, fullerene, quantum dots, carbon lattices, nanotubes etc.

One-dimensional Nanomaterial

Nanotube and nanowire.

Two-dimensional Nanomaterials

Self assembled monolayer film.

SOLID LIPID NANOPARTICLES (SLNS)

Solid Lipid Nanoparticles are produced from lipids, which are firm at room temperature. The solid lipid is melting and the drug is incorporate into it. The whole system is stabilized by surfactant [23]. The matrix of the lipid particle formed is solid and therefore it can guard medicine particles against chemical ruin. Addition a liquid phospholipid (oil) to an oil/water emulsion covering a solid lipid or mixture of solid lipids, support the creation of SLN [24]. Due to their minor size (50-1000 nm) and biocompatibility, SLNs might be used in the meadow of pharmaceutical for various routes of administration, such as parenteral, oral and percutaneous routes [25]. Polymeric nanoparticles offer several definite advantages over Nano emulsion and liposomes. For instance, the assistance to boost the steadiness of drug/proteins and useful controlled release properties [26].

NANOEMULSIONS

It can be defined as thermodynamically constant isotropic system, containing translucent dispersions of oil and water steadied by an interfacial film of surfactant particle. Nano emulsion droplets frequently have the droplet size between 10 to 100 nm. Nano emulsion droplets of both o/w as well as w/o types. The observed clarity of these systems is because the extreme size of Nano emulsion droplets is less than one-fourth (25%) of the wavelength of visible light which is approximately 150 nm [27 - 29].

LIPOSOMES

A liposome is a small bubble (vesicle), made out of the similar material as a cell membrane. Liposomes can be filled with drugs, and used to deliver drugs for tumor and other diseases [30]. Liposomes are sphere-shaped, self-enclosed

structures with a lipid bilayer (ranging from approximately nanometers to several micrometers) that possesses and unique and amphiphilic character [31]. Silymarin liposomal vesicles remained prepared by ethanol injection technique to evaluate its hepatoprotective and gastro protective activity in mice against carbon tetrachloride induced hepatotoxicity. Result indicates 55 percent hepatoprotective activity by silymarin liposomes when related to non-liposomal silymarin [32]. Liposomal systems have stayed found to be useful and effective in targeting to liver cells. Galactosylated liposomes of silymarin have capability to target to hepatocytes by attaching to lectin receptors existing on the liver cells [33]. The preparation was found more efficacious than silymarin suspension in protecting the liver against paracetamol noxiousness and the related inflammatory conditions.

CONCLUSIONS

Herbal medicines have been recently attainment extra attention because of their potential to treat nearly all diseases. However, various herbal medicines possessed poor aqueous solubility, physical instability, low absorption, lesser bioavailability and pharmacological actions. To overcome these disadvantages, drug delivery systems that contain Nano carriers have been developed. The concerted examination among the old "Herbal medicines" and fresher methods of recent medicine delivery system.

Nanotechnology is quickly expanding and potentially beneficial field with tremendous implication for industry, medication and cosmetics. The grouping of nanotechnology with traditional herbal drug might provide a very valuable tool in designing future herbal drug through enhanced bioavailability profile and less toxicity. "Nanotechnology" has established the attractive treatments to the medical that will improve health of people.

Nanotechnologies have the assets of self-targeting in the logic that without the association of a precise ligand, the nanoparticles know how to be used aimed at pointing, owing to their idiosyncratically little size, at the unhygienic pathological areas. By analyze the connection among biological treatment and nanotechnology, the application of Nano technological systems for

bioavailability enrichment of herbal medicines can be brought nearby among the purpose of nanotechnology of nanomization of herbal drugs.

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