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NANOTECHNOLOGY FOR DELIVERY OF HERBAL DRUGS

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ABSTRACT

Herbal medicines are widely used in worldwide since ancient time. Now a day nanotechnology is a new prospective in all scientific and technological fields. There are different varieties of new herbal formulations in nanotechnology like nanoparticles, nanocapsules, nanoemulsions etc. The herbal drugs in form of nanoparticles give better effects than the allopathic medicines and can cure disease and reduce the adverse effects of the drugs. It releases drug in sustained manner and reduce the repeated administration to overcome patient compliance and increase the therapeutic effect of drug. Nano-sized drug delivery system enhance the activity of drug. Some extracts, such as flavonoids, tannins and terpenoids are highly water soluble but poorly lipid soluble which can cause decrease in absorption by nanotechnology it is also overcome. Integration of the nanocarriers as NDDS is the traditional system is essential to conflict more chronic diseases like asthma, diabetes, cancer and other. Nanotechnology system can deliver desire concentration of drug at the specific site of action. Nano formulation is increasing the particle size and increase the surface area due to that bioavailability also increase and it is useful for the treatment, diagnosis, monitoring and control of biological system and have recently been referred to as nanomedicine. Nanotechnology can protect from toxicity, physical and chemical degradation of drug. This review is mainly focus on concept of nanotechnology in herbal drugs.

KEYWORDS: Nanotechnology, Novel drug delivery system, Herbal.

INTRODUCTION

Herbal medicines have been widely used worldwide since ancient times and have been recognized by physicians and patients for their better therapeutic values as they have fewer adverse effects as compared to modern medicines.[1] The herbal treatment helps to increase

the therapeutic value by reducing the toxicity and side effects of drugs at the same time it also increases the bioavailability. The applications of nanotechnology for treatment, diagnosis, monitoring, and control of biological systems have recently been refer to as nanomedicine. The nanocarriers have been made of safe materials including synthetic biodegradable polymers, lipids and polysaccharides.[2] The known effects and no side effects have made natural products/herbal drugs a powerful therapeutic solution to the organisms. But the delivery of plant/herbal therapeutic molecules as drugs is problematic due to poor solubility, poor permeability, low bioavailability, instability in biological milieu and extensive first pass metabolism.[3]

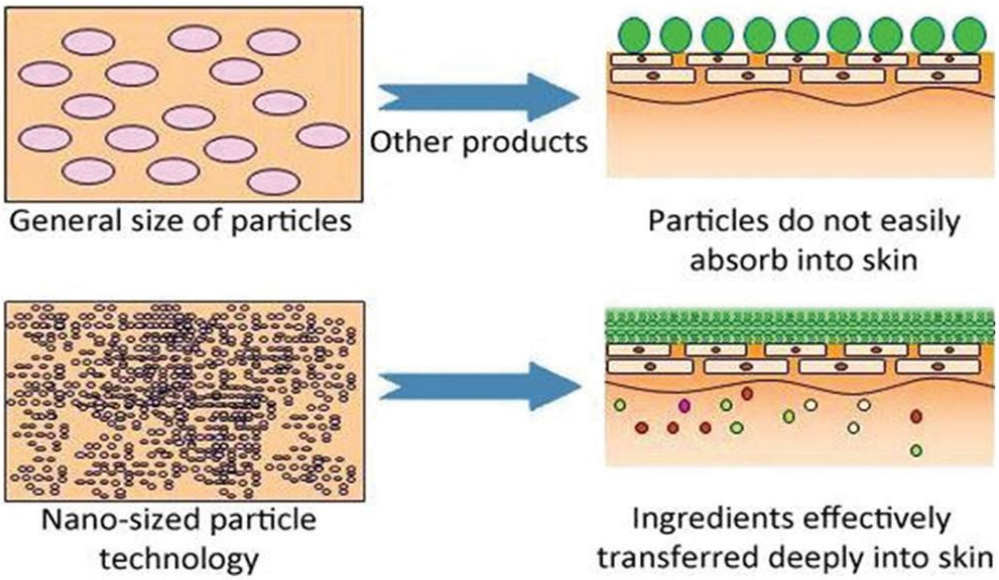

Fig.1: Transport of drug molecules through skin.[4]

Needs of nanotechnology in herbal drug delivery[5-6]

- To target the herbal medicine to individual organ which improves the selectivity, drug delivery, effectiveness and safety and there by reduces dose and increase patient compliance.
- To increase the herbal drug solubility and help to localize drug in a specific site thus resulting in better efficacy.
- They are able to deliver high concentrations of drugs to disease sites because of their unique size in high loading capacities.
- Delivering the drug in small particle size enhance the entire surface area of the drugs therefore allocating faster dissolution in the blood.
- Shows enhance permeation and retention effect.

- Decreases the side effects.
- The concentration seems to persist at the sites for the longer periods.

Types of nanoparticles[7]

Table 1: Inorganic nanoparticles.

Inorganic compound	Description	Size range (nm)
Metallic	Gold and silver particles	<50
Magnetic	Super paramagnetic iron oxide particles	5–100
Nanoshells	Dielectric silica core in a thin gold metal shell	10–300
Ceramics	Inorganic porous biocompatible materials	<100

Table 2: Organic nanoparticles.

Organic compound	Description	Size range(nm)
Carbon tubes	Cylindrical graphite sheets	1.5–5000
Quantum dots	Semiconductor crystals with a cadmium core and metal shell	<10
Dendrimers	Highly branched macromolecules	5–20
Liposomes	Phospholipids	5–100
Polymers	Colloidal particles	10–1000

Method of preparation

1. **High pressure homogenization method[8]**

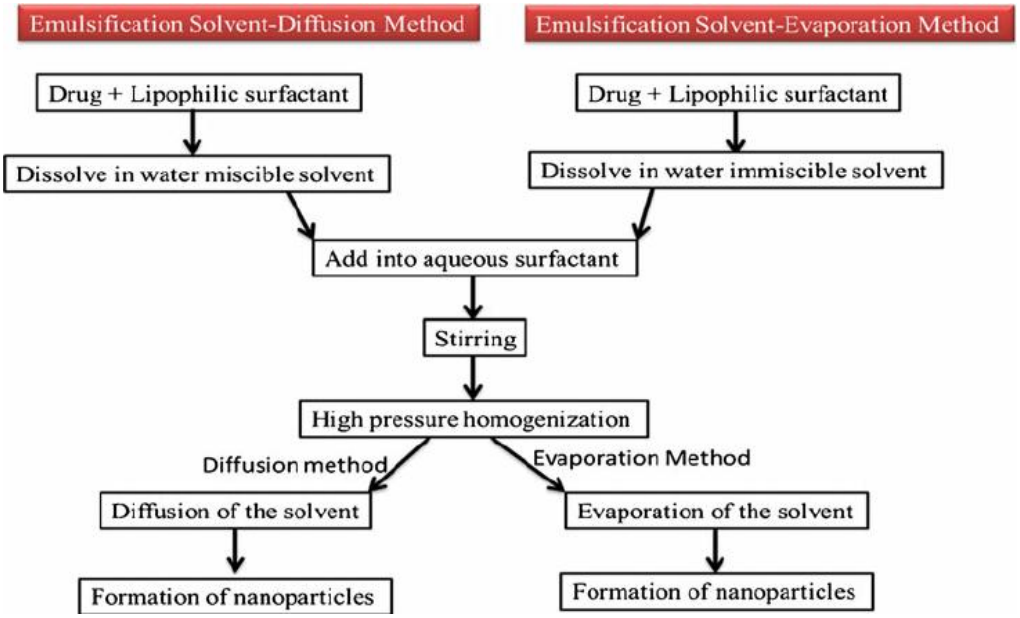

Fig. 2: High pressure homogenization method.

2. **Complex coacervation method[9-11]**

This is a spontaneous phase separation process of two liquid phases in colloidal system, which results by the interaction of two oppositely charge polyelectrolytes upon mixing in an

aqueous solution. This method has been reported to provide good dispersion stability to poorly water-soluble drugs.

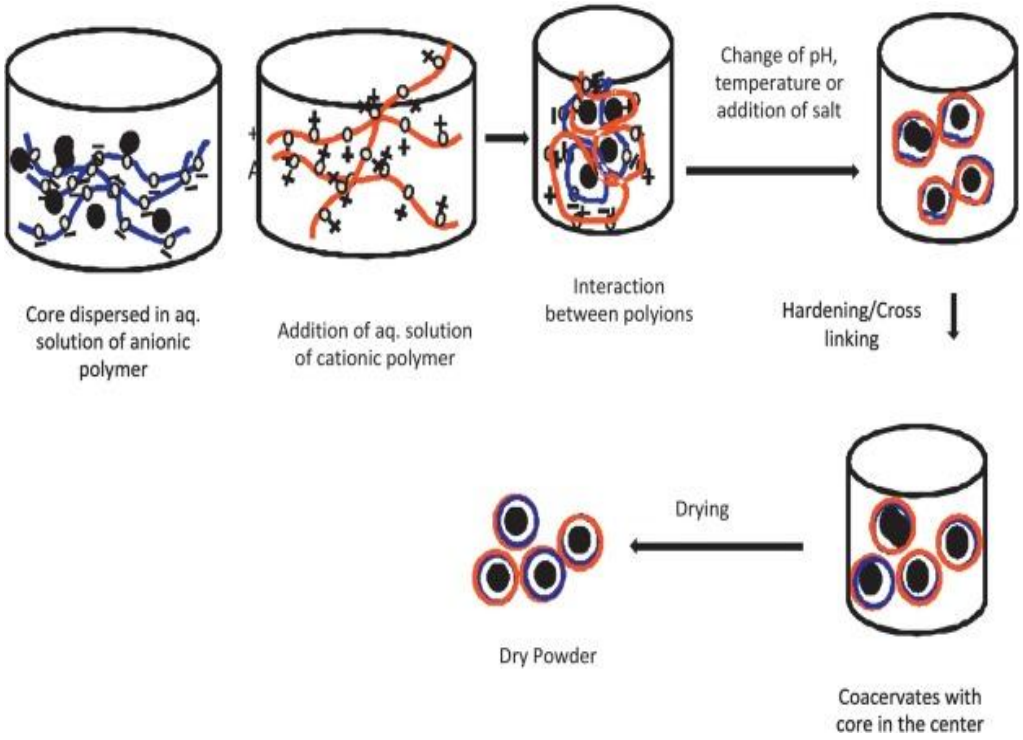

Fig. 3: Complex coacervation method.

3. Salting out method[12]

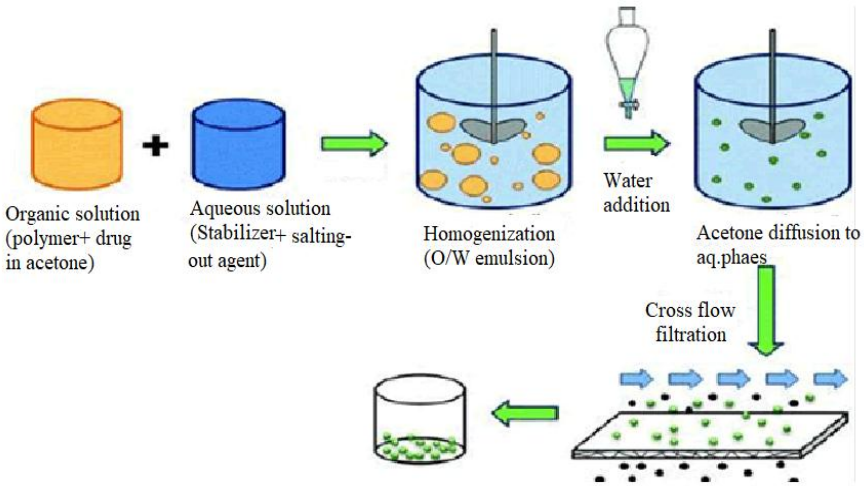

Fig. 4: Salting out method.

4. Solvent emulsification-diffusion method[13]

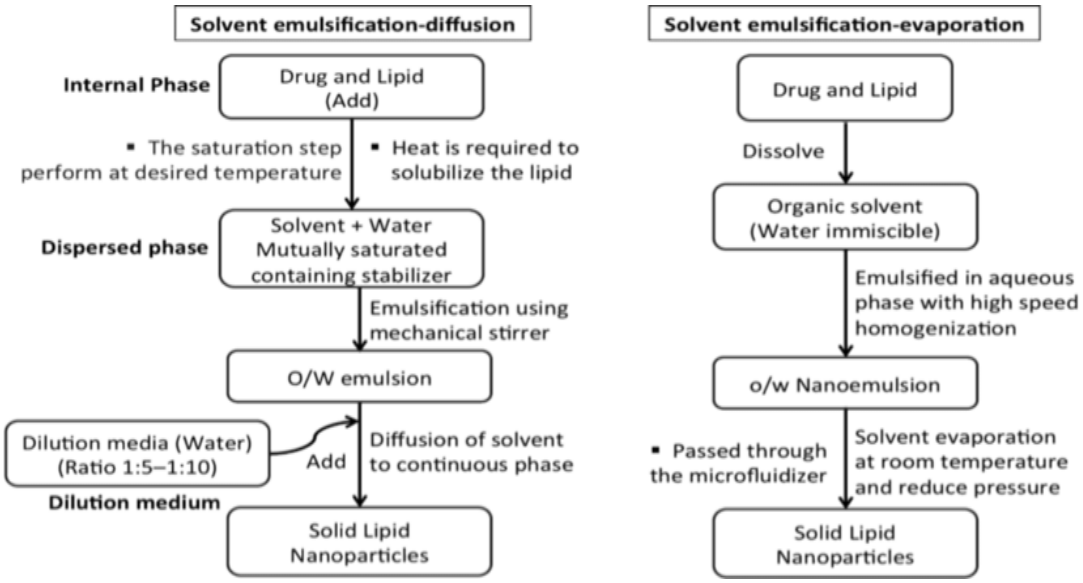

Fig. 5: Solvent emulsification–diffusion method.

Characterization of synthesized nanoparticles

1. Scanning electron microscope (SEM)

Scanning electron microscopy (SEM) is giving morphological examination with direct visualization. The technique is based on electron microscopy which can be used for morphological and sizing analysis; however, they provide limited information about the size distribution.[14]

2. Transmission electron microscope (TEM)

Transmission electron microscope is complex and time consuming because of its requirement that sample should be ultra-thin for the electron transmittance.[15]

3. Particle size analyzers

Particle size distribution and morphology of the nanoparticles are most important parameters for characterization of synthesized nanoparticles.[16]

4. Dynamic light scattering (DLS)

Dynamic light scattering is widely used to determine the size of Brownian nanoparticles in colloidal suspensions in the range of nano and submicron.[17]

5. Atomic force microscopy (AFM)

Atomic force microscopy offers ultra-high resolution in particle size measurement and is based on a physical scanning of samples at sub-micron level using a probe tip of atomic scale.[18]

6. Surface area analysis

Brunauer Emmett Teller (BET) analysis method is commonly used to determine the total surface area of nanoparticles.[19]

Applications of nanotechnology in delivery of herbal drugs and nutraceuticals [20]

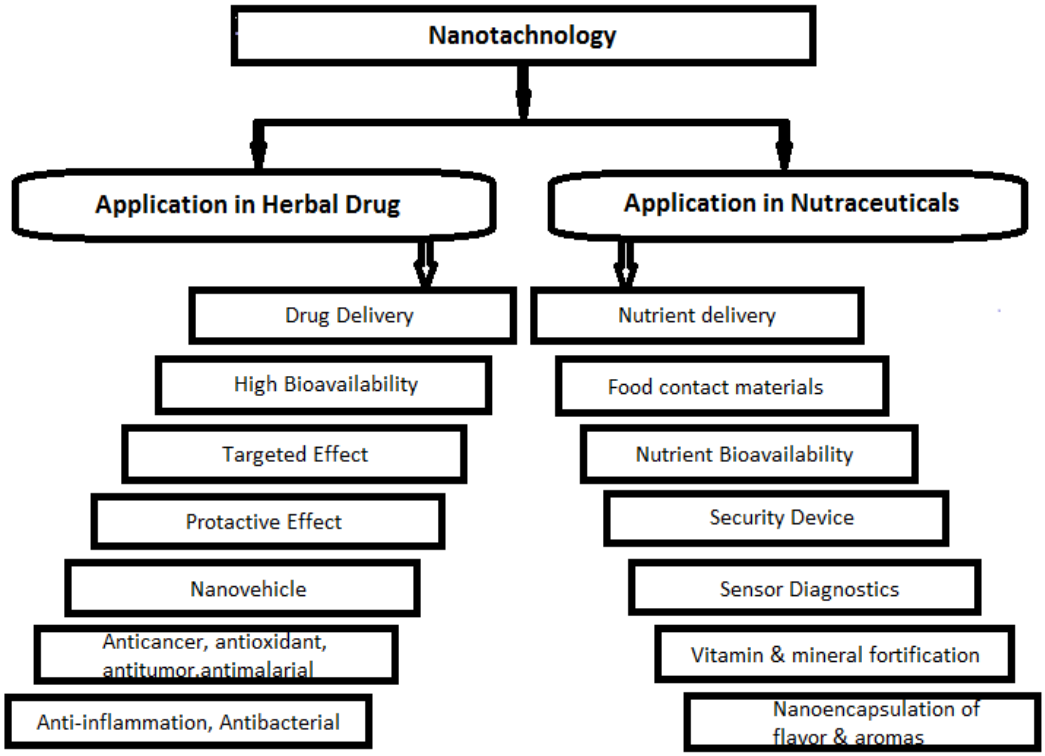

Fig.6: Different applications of herbal nanotechnology.

Examples of natural compounds extracted from higher plants used in nanomedicine aiming different approaches. Some of these extracts are as shown in Fig.7

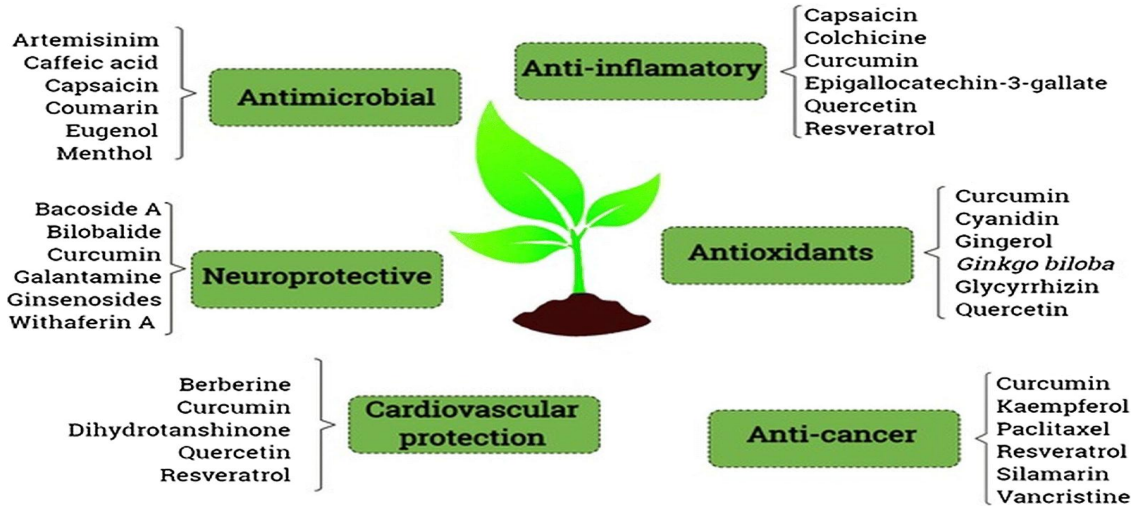

Fig.7: Examples of natural compounds use for different approaches.

Table 3: Herbal nanoparticles formulations and their use.[21-29]

Name of herb	Category	Uses
Curcumin	Anticancer	Potent anticancer and antitumor
Paclitaxel	Antineoplastic	Acts against several tumour, ovarian and breast cancer
Berberine	Anticancer	Inflammation and several cancers
Camptothe-cin	Anticancer	Potent anticancer
Ginkgo biloba	Alzheimer's dementia	Acts against loss of memory, thinking, language, behavior.
Triptolide	Anti-arthritis	Inflammatory and autoimmune diseases, especially for rheumatoid arthritis.
Salvia miltiorrhiza	Anti-hyperlipidemia	Cerebrovascular diseases, improve blood stasis.
Quercetin	Anti-oxidant	Potent anticancer
Breviscapine	Anti-cardiovascular	Cerebrovascular and cardiovascular diseases also against pulmonary fibrosis.
Naringenin	Antioxidant, anti-inflammatory	Treating metabolic syndrome, reducing oxidative damage to DNA
Dodder	Anti-inflammatory	Liver problems and spleen problems
Silymarins	Hepatoprotective	Several liver diseases, breast cancer.
Genistein	Antioxidant, Anticancer	Used in cardiovascular diseases, breast and uterine cancer also in osteoporosis.
Annual-mugwort	Antimalarial	In malaria, dysentery, diarrhoea, flu, colds.
Centellaasiatica	Anxiolytic	Acts as anti-anxiety, also used in leprosy, cancer, syphilis &allergy.

CONCLUSION

Overall, this review indicates that nanotechnology has great potential for delivering herbal drugs, and used in various health problems. The combination of nanotechnology with traditional herbal medicine may provide a very useful tool in designing future herbal medicine with improved bioavailability and less adverse effects. Nanotechnology is rapidly expanding and potentially beneficial field with tremendous, implication for industry, medicine, cosmetics.

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