



GREEN HERBS NANOSUSPENSION: A REVIEW

Nidhisha Raj MD¹, K Krishnakumar¹, Dineshkumar B²

¹Dept. of Pharmaceutics, St James College of Pharmaceutical Sciences, Chalakudy, Thrissur, Kerala, India.

²St James Hospital Trust Pharmaceutical research Centre (DSIR Centre), Chalakudy, Thrissur, Kerala, India.

ABSTRACT

Advances techniques have been used to develop novel drug delivery systems (NDDS) for plant actives and extracts. Nanotechnology for drug delivery has gained much interest as a way to improve the solubility problems. Nano suspensions and nanoparticles are part of nanotechnology. This may interact with the body at molecular scales with a high degree of specificity and designed to achieve maximum therapeutic efficacy. The nano-formulations are reported to have remarkable advantages over conventional formulations of plant products which include enhancement of solubility, stability, protection from toxicity and enhancement of pharmacological activity. The present review highlights the development of nano-formulation of phytoconstituents, summarizes their formulation and biological activity.

Keywords: NDDS, Nano suspension, Nanotechnology.

INTRODUCTION

Nano-drug delivery system has become multidisciplinary in the field of pharmaceutical technology. In present era, it significantly promotes the formation of biological medicine and bioavailability enhancement of phytomedicines [1,2].

Herbal medicines are extensively used all over the world since ages. The efficacy of medicinal plants relies on the release of biologically active compounds. The majority of the phyto-compounds are incapable to pass the lipid membranes of the cells because either they have markedly high molecular size/weight and poor aqueous solubility, thereby it leads to poor absorption, poor solubility and poor bioavailability [3,4]. Many phytomedicines, thereby due to their poor absorption and solubility, exhibit no considerable biological activity in an in vivo model despite of their amazing biological activity in an in vitro model. Due to these problems, some medicinal plant extracts are not used clinically. It has been extensively suggested to include herbal drugs with nanotechnology can be capable to promote the biological action of herbal constituents/extracts by decreasing the essential dosage [5,6].

Nanosuspension technology has been introduced by formulation scientists and has been evolved as a potent candidate for the delivery of the poorly water soluble drugs. A pharmaceutical nanosuspension is defined as a

very finely dispersed solid drug particles in an aqueous vehicle which is stabilized by surfactants. This nanosuspension formulation can be suitable for oral, topical use or parenteral administration due to its minimized particle size, leading to increased dissolution rate, leads to increase the bioavailability of the drug [7,8]. The diameter of the suspended particle is less than 1 μm in size (i.e. 0.1nm-1000 nm). The particle size distribution of the solid particles in nanosuspensions is usually less than 1 μm with an average particle size ranging between 200 and 600 nm [9, 10].

Benefits of Nanosuspensions [11, 12]

- Increase in the dissolution velocity and saturation solubility of the drug.
- Improved biological performance.
- Ease of manufacture and scale up.
- Long term physical stability.
- Can be incorporated in various dosage forms such as pellets, tablets, suppositories and hydrogels for various routes of administration thus providing their versatility.
- Most cost effective.
- Useful for poorly soluble drugs.
- Physically more stable than liposomes.
- Provide ease of manufacture and scale up for large scale production.

- Rapid dissolution and tissue targeting.
- Reduction in tissue irritation.
- Higher bioavailability in ocular and inhalational drug delivery

Formulation of nanosuspension GREEN HERBALS NANOSUSPENSION

Curcumin is the main phytochemical and yellow-orange compound present in turmeric. But curcumin has limited absorption due to its poor water solubility and limits its use as a potential therapeutic. Therefore, study was made to overcome the above limitations by curcumin delivery through nanotechnology. Nanocurcumin solid dosage formulations were prepared and studied for its dissolution behaviour. Nanosuspensions of curcumin was formulated by high pressure homogenization to overcome problems caused by poor aqueous solubility. Homogenization process can increase in surface area enhances the dissolution rate. Considerable improvement in the dissolution behavior was observed in the drug nanocrystal-loaded solid dosage forms [16].

Silybum marianum commonly known as milk thistle is a member of *Asteraceae* family and genus *Silybum*. Silymarin is the major bioactive compound isolated from its seed which has innumerable applications. Silymarin is used for the oral therapy of chronic liver disorder but it has poor aqueous solubility thereby poor bioavailability. The nanosuspension of this poor aqueous soluble plant extract enhance their bioactivities. Nanosuspensions of silymarin was prepared by *nanoprecipitation method* using tween 80, SDS and Poloxamer 188 as stabilizers. The lyophilized formula contained 5% mannitol as cryoprotectant. The silymarin nanosuspension showed drug particle size was about 100-300 nm, and the particles had ball-like shape and good dispersive properties [17].

Coriandrum sativum commonly known as coriander has various pharmacological properties. Like, hepatoprotective, anti-inflammatory, antihypertensive, antiedemic, antiseptic, antidiabetic, lipolytic and myorelaxant activities. Hepatotoxicity is the major factor responsible for drug withdrawal from the market. There is no doubt that hepatotoxicity requires considerable attention and that every viable measure to be taken towards an efficient mechanism for hepatoprotection. Nanosuspension containing *Coriander sativum* was

prepared by Solvent Evaporation method followed by homogenization. Nanosuspensions containing *Coriander sativum* crude extract enhanced the hepatoprotective activity of male swiss albino mice with hepatotoxic liver [18].

High-pressure homogenization (HPH) was used to increase the water solubility of quercetin crystals, which exhibit antioxidant, anti-inflammatory, and anticancer properties but poor water solubility and oral bioavailability. The improved water solubility of quercetin by HPH treatment could be attributed to very fine suspensions produced in the nanometric range (~400 nm) and loss of crystallinity caused by mechanical friction and stresses [19].

Quercetin nanosuspension (QNS) has been formulated and investigated its anti-tumor activity against Dalton's lymphoma cells (DLA) in an in vitro model. Since quercetin is insoluble in water, it has been formulated into nanosuspension in order to improve the solubility as well as dissolution rate of the drug. Quercetin nanosuspension (QNS) was formulated using homogenization method. The results showed that Particle size of the QNS was found to be within the range of ~160-200nm. This study concluded that formulated QNS exhibited potent antioxidant activity as well as anti-tumor activity at dose-dependent manner [20].

Elettaria cardamomum generally known as cardamom has well-known culinary value. Seeds of this plant are used in folk medicines for the treatment of cardiac and gastrointestinal disorders. It was found that the nanosuspension of the poor aqueous soluble plant extract of cardamom enhance their bioactivities. Nanosuspensions of *E. cardamomum* was prepared by *nanoprecipitation method*. *Elettaria cardamomum* nanosuspension was found to have more antioxidant activity [21].

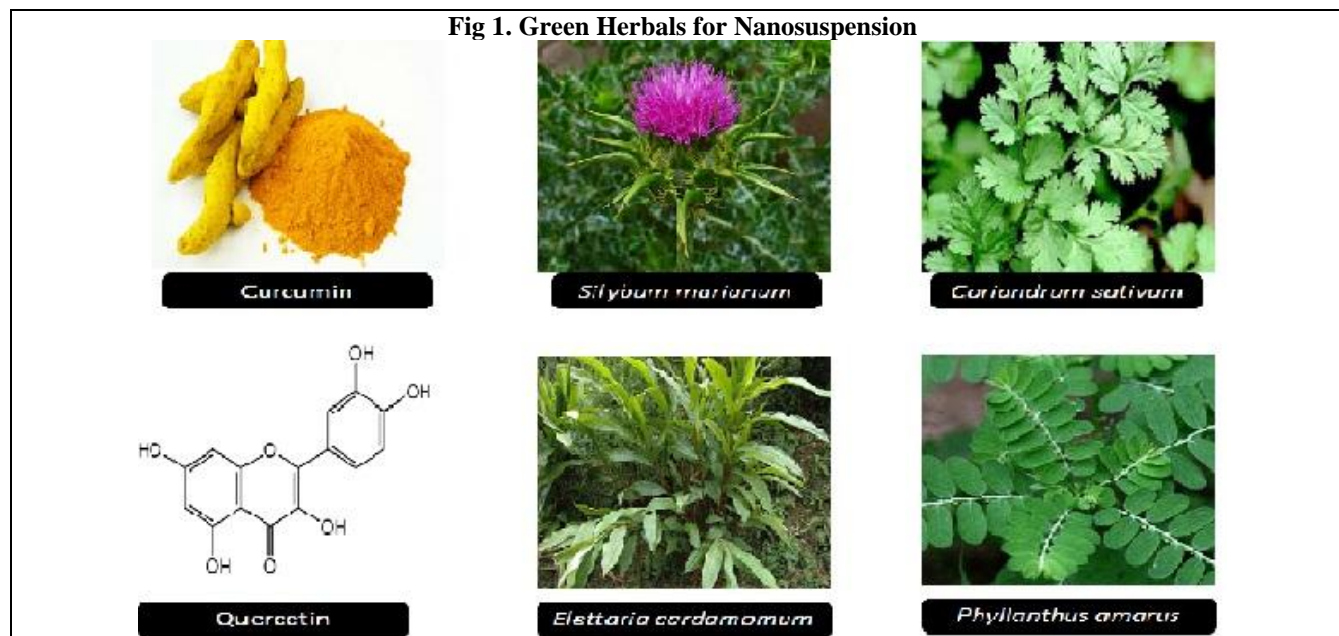
Phyllanthus amarus is commonly used for traditional Indian medicine and as dietary adjuncts for the treatment of numerous physiological disorders including hepatic disorders. Due to the poor water solubility of its major constituents such as lignans and flavonoids, its absorption upon oral administration could be limited. The present study suggested that the nanoparticles system can be applied to overcome other poorly water soluble herbal medicines and furthermore to decrease the treatment dosage [22].

Table 1. Formulation consideration for nanosuspension

Excipients	Functions	Examples
Stabilizers	Wet the drug thoroughly, prevent Oswald's ripening and agglomeration of nanosuspensions, providing steric or ionic barrier.	Lecithin, poloxamers, polysorbate, celluloses, povidones [13].
Cosurfactants	Influence phase behavior when micro emulsions are used to formulate nanosuspension.	Bile salts, dipotassium glycerolrhizinate, glycofurol, ethanol, isopropanol, triscutol [14].
Organic solvent	Pharmaceutically acceptable less hazardous solvent for	Methanol,

	preparation of formulation.	ethanol, chloroform, isopropanol, ethylacetate, ethylformate, butyl lactate, propylene carbonate, benzyl alcohol triacetin [15].
Other additives	According to the requirement of the route of administration/properties of the drug moiety.	Buffers, salts, polyols, osmogens, cryoprotectant [15].

Fig 1. Green Herbals for Nanosuspension



CONCLUSION

Herbal drugs have been recently getting more attention because of their potential to treat almost all diseases. However, several problems such as poor solubility, poor bioavailability, low oral absorption, instability and unpredictable toxicity of herbal medicines limit their use. In order to overcome such problems, nanoparticles can play a vital role. Hence, nanosuspension show case potential utilization to deliver herbal medicines with better therapy. Nanosuspensions have appeared as a promising strategy for the efficient delivery of hydrophobic drugs, because of the versatile features and

unique advantages. Production techniques such as bottom up technique and top down technique have been successfully employed for large-scale production of nanosuspensions of phyto-constituents.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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