Nanophytomedicines: A Novel Approach to Improve Drug Delivery and Pharmacokinetics of Herbal Medicine

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ABSTRACT: Novel drugs delivery systems, formulations from plant actives and extracts are still a matter of thrust and hot cake among the current researchers. Nanophytomedicines are prepared from active phytoconstituents or standardized extracts. In this area, novel delivery systems such as polymeric liposomes, colloidisomes, aquasomes, ethosomes, niosomes, proliposomes, phytosomes, nanoparticles, nanocapsules, nanoemulsions, microsphere and transferosomes have been proven to be a better carrier for delivery of the phyto-constituents by recent researches. Due to improved bioavailability, protection from toxicity, enhanced pharmacological activity, better stability, improved tissue macrophages distribution, sustained delivery, and protection from physico-chemical degradation, novel delivery systems are more suitable delivery system in compare to the conventional systems. Present paper attempts to spotlight recent trends or approaches in development of nanophytomedicines.

Keywords: Nanophytomedicines, Bioavailability, Bioactivity, Nanotechnology, Drug delivery

INTRODUCTION

Plenty of the drugs in current usage are derived either directly from natural sources or are chemical analogues of natural origin molecules. The primary handicap in harnessing the hitherto unrealized potential of phytomedicines has often been the poor in vivo response of actives that have otherwise demonstrated excellent in vitro pharmacological activity. The reasons have been manifold; ranging from poor solubility profiles and impaired membrane permeability to inadequate deposition of drug at the site of action. Novel drug delivery systems are increasingly being applied as effective tools in overcoming these issues and helping design physiologically effective phytoformulations (Mukne et al., 2017; Saraf et al., 2015). The ideal drug delivery system should be able to target the drug release at the site of action in a controlled manner so as to obtain optimum therapeutic effect with minimal side effects.
drug development apropos nanophytomedicines, in light of published reports. Searches were not limited by date or place of publications but to publications available in English. Present report examined the available literature up to March 2017.

RESULTS

Phytomedicines are gaining popularity these days owing to their natural origin and less side effects. Herbal powders, extracts or isolated active phytoconstituents, despite of impressive in-vitro activity, generally show least or non-significant efficacy in in-vivo investigations due to their poor solubility (aqueous/lipid) and stability, poor lipid solubility, non-uniform particle size, poor absorption and bioavailability, destruction of few plant extracts in gastric juice (during gastric emptying), rapid clearance and biotransformation. A number of nanotechnology approaches and novel drug delivery systems, such as liposomes, niosomes, nanospheres and phytosomes have been investigated to improve the herbal drug delivery (Abhinav et al., 2016). Applications of nanotechnology have been reported potentially effective in improving the bioavailability and bioactivity of phytomedicines. Some of the key advanced methods that can be adopted are: (I) Reducing particle size of phytomedicines to nanosize (Li et al., 2012), (II), Attaching certain polymers of micro/nano materials with phytomedicine (Li et al., 2009; Yadav et al., 2011) (III) Using nano-structured carrier systems for phytomedicines (Zhao et al., 2010) and (IV) Modification of surface properties of phytomedicines (Chen et al., 2009; Tiwari et al., 2012). Surface properties of phytomedicines can be modified by coating with hydrophilic, stabilizing, mucoadhesive polymers or surfactants.

![Diagram of Phytomedicine and Nanotechnology Approaches](image)

Fig. 1. Application of nanotechnology on phytomedicine and its benefits.
These methods modify the zeta potential of nanoparticles, improves stability and particle uptake (Tiwari et al., 2012). Evidences suggest that incorporating nanotechnology in formulation of phytomedicine may be likely to provide several advantages (Fig.1) (Sahni et al., 2011; Jain et al., 2011; Lambert, 2010, Liong et al., 2008). Several reports elucidated improved biological activity and therapeutic potential of phytomedicines by integrating nanotechnology approaches and converting them to nanophytomedicines. For instance, nanosized herbs such as Cuscuta chinensis (prepared by nano-suspension method) and Radix salvia (prepared by spray drying method) shown improved bioavailability, biological actions, and manifold reduction in therapeutic dose (Yen et al., 2008; Su et al., 2008). Nano emulsified ethanolic extract of Phyllanthus amarus Schum & Thonn showed better hepatoprotective activity than Phyllanthus amarus Schum (100 mg/kg body weight) and also repeated dose oral toxicity proved to be safe (Deepa et al., 2012).

### Table 1: Examples of recent developments in nanophytomedicines.

<table>
<thead>
<tr>
<th>Medicinal plant</th>
<th>Nano-formulations</th>
<th>Method</th>
<th>Active ingredient</th>
<th>Rationale</th>
<th>Therapeutic targets studied</th>
<th>Ref.</th>
</tr>
</thead>
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<tr>
<td>T. wilfordii Hook F</td>
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<td>Retinoblastoma therapy</td>
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<td>To improve the hydrophilicity &amp; bioavailability</td>
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<tr>
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<tr>
<td>S. miltiorrhiza Bunge</td>
<td>Tanshinone IIA nanoemulsion</td>
<td>Emulsification/hi gh pressure homogenization</td>
<td>Tanshinone IIA</td>
<td>To improve the hydrophilicity &amp; bioavailability</td>
<td>Cytotoxicity evaluation against human bladder cancer cells</td>
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<tr>
<td>S. miltiorrhiza Bunge</td>
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</tr>
<tr>
<td>A. annua L.</td>
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<td>Artemisinin</td>
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</tr>
</tbody>
</table>

Likewise, few more developments in nanophytomedicines have been observed recently (Table 1) (Li et al., 2012; Shi et al., 2012; Kundu et al., 2012; Han et al., 2012; Zhang et al., 2011; Chang et al., 2011; Hu et al., 2010; Sutthanut et al., 2009; Zhao et al., 2009; Zhang et al., 2012).

**CONCLUSION**

Present report reflects promising future of nanophytomedicines to enhance the bioactivity and surmount the concerns associated with herbal medicines. Nevertheless, limited works on nanophytomedicines are available, and majority of such investigations are carried out on phytomedicine of Chinese or Thai origin. The benefits of nanophytomedicines are indubitable and unstoppable; and there is a pressing need to encourage such researches in Indian setting to explore vast potential of Ayurvedic medicinal plants.

**REFERENCES**


