THERAPEUTIC POTENTIAL OF MEDICINAL PLANTS DERIVED NANOPARTICLES: A REVIEW

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ABSTRACT
Medicinal plants have been an indispensable component of traditional and modern system of healthcare and medicine. The same have been utilized for treatment of innumerable diseases. Synthesis or production of the wide ranges of phytocompounds with one or many biological or pharmacological activity such as antimicrobial, anti-inflammatory, anticancer, antiaging, anti diabetic, antioxidant activity etc. is responsible for medicinal property of plants. However, there has been concern related to solubility, molecular size and absorption of such phytocompounds. Utilization of many biological active phytocompounds gets restricted occurring to their inability to cross cell membrane. With advancements in the field of nanotechnology, an alternate has arised which involves, synthesis of medicinal plant derived nanoparticles and their applicability to be utilized as therapeutic agents. The present review provides an insight into the application of nanoparticles synthesized from different parts of plants.

KEYWORDS: medicinal plant, nanoparticles, anticancer, antimicrobial, antioxidant

INTRODUCTION
Medicinal plants have been utilized in treatment of numerous diseases, disorders and ailments since ages. Medicinal plant and their product have serve to be backbone of traditional as well as modern system of medicine. The inherent potential; of medicinal plants is attributed to presence/ synthesis of various phytocompounds with several biological / pharmacological activity or medicinal property. However, these phytocompounds beside being medicinally important, also has a constrain of low absorption owing to several reasons including possible large molecular size, inability to cross lipid bilayer (cell membrane) (Bonifacio et al 2013). With advent and development of nanotechnology, there has been a momentum application of nanotechnology to synthesize nanoparticles from medicinal plants and
to analyze their therapeutic potential. There are several advantages associated with nanoparticles being utilized for therapeutics / medicinal purposes including development of novel formulations, improved, drug delivery system tissue / organ specific activity improved activity, reduction in side effects, reduced doze etc. (Ghosh et al 2013, Rajendra et al 2013). Beside possessing numerous advantages their exist some concerns associated with utilization of nanoparticles. There is simultaneous requirement of analysis of ecological impact of nanoparticles and how their release into the environment will affect ecosystem. Moreover, optimization is required for scaling up of synthesis of nanocomposition from various sources.

**ANTIMICROBIAL ACTIVITY**

In recent past several microorganisms have become resistant to action of antibiotics synthesis of nanoparticles and their antibiotic potential have established many nanoparticles synthesized from various medicinal plant as potent antimicrobial agent (Bergmann et al 2012). Evaluation of antimicrobial potential (both against bacteria and fungi) of nanoparticles have been a common approach and since therapeutic potential of nanoparticles was recognized. Several studies have been conducted to analyze antimicrobial potential of nanoparticles / nanocomposites prepared from medicinal plants (Table 1). Uthaya et al (2018) reported antibacterial activity of nanoparticles prepared from *Abutilon indicum* against both gram positive and gram negative bacteria. In another study Rebecca et al (2014) reported antibacterial and antifungal activity of nanoparticles prepared from seeds of *Argyreia nervosa* against *Staphylococcus aureus*, *Bacillus subtilis* and *Aspergillus niger*. Krishna raj et al (2011) also reported antibacterial potential of nanoparticles prepared from leaf extract of *Acalypha indica* against water borne pathogen. In independent studies conducted by Mahmuda et al (2018) and Reddy et al (2019), antibacterial activity of nanoparticles prepared from leaf extract of *Brassica rapa* and *Crica papaya* was reported respectively. Nagyan et al (2018) prepared nanoparticles from fruit residue of *Coccenina indica* and reported its activity against drug resistant pathogens. Raviya and Srinivasan (2011) reported nanoparticles prepared from peel extract of *Citrus sinensis* to be effective antibacterial agent. Rajendra et al (2013) reported enhanced antimicrobial activity of nanoparticles of *ocimum sanctum* against *E. coli*, *S. aureus*, *P. aeruginosa* and *B. subtilis* as compared to antimicrobial activity of some plant extract in free form.

**PHARMACOLOGICAL ACTIVITIES**

However, beside antimicrobial activity substantial work has been carried out to reveal or analyze other biological, pharmacological and medicinal activity (potential) of nanoparticles prepared from different parts (fruits seeds, leaves etc.) of medicinal plants. Indumathy et al (2014) synthesized nanoparticles from plant *cassia fistula* and reported antioxidant, anticancer activity of prepared nanoparticles along with their antimicrobial activity. Nanoparticles prepared from leaf extract of *Canthellia asiatica* were found to serve as potential reducing and capping agent (Das et al 2010). Nakkala et al (2014) also reported nanoparticles synthesized from *Acorus calamus* to possess antioxidant, antibacterial and anticancer activity. Nanoparticles obtained from leaves of *Calotropis procuia* have been reported to be effective reducing and stabilizing agent (Gawade et al 2017). Among several nanoparticles silver nanoparticles synthesized from various sources which have been reported to possess widespread applications including antimicrobial activity, larvicidal activity, wound healing property etc. (Firdhouse and Lalitha 2015). In independent studies conducted by Firdhouse and Lalitha 2013 and Tripathi et al 2009 silver nanoparticles prepared from *A. dubius* and *Azadirachta indica* respectively reported antibacterial activity resistance to bacterial growth on cotton clothes onto which nanoparticles were incorporated. Specifically reported resistance towards sweat bacterium *corynebacterium*. Several studies have also implicated wound healing activity of nanoparticles (Gunasekaran et al 2011, Hendi 2011). Sudjarwo et al 2018 reported nanoparticle extract of leaves of *Pinus merkusii* to possess immunostimulatory activity. Kota et al (2017) synthesized silver nanoparticles with leaf extract of *Rumex acetosa* and were reported to possess antioxidant activity. Beside this the study also reported antibacterial activity of silver nanoparticles against sixteen human pathogens.

**ANTICANCER ACTIVITIES**

Table 1: Summary of biological activity of synthesized nanosuspension prepared from different plants

<table>
<thead>
<tr>
<th>Plant</th>
<th>Activity of synthesized nanoparticles / nanosuspension</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocimum sanctum</td>
<td>Antimicrobial activity against <em>E.coli</em>, <em>P.aeruginosa</em>, <em>S.aureus</em></td>
<td>Rajendra et al 2013</td>
</tr>
<tr>
<td>Acorus calamus</td>
<td>Antioxidant, antibacterial, anticancer</td>
<td>Nakkala et al 2014</td>
</tr>
<tr>
<td>Calotropis procera</td>
<td>Reducing and stabilizing agent</td>
<td>Gawade, et al 2017</td>
</tr>
<tr>
<td>Acalypha indica</td>
<td>Antibacterial and water borne pathogen</td>
<td>Krishnaraj, et al 2011</td>
</tr>
<tr>
<td>Cantella asiatica</td>
<td>Redcing and capping agent</td>
<td>Das et al 2010</td>
</tr>
<tr>
<td>Centella asiatica</td>
<td>Antiaging and show antioxidative effects</td>
<td>Arora and Baliga 2013</td>
</tr>
<tr>
<td>Cassia fistula</td>
<td>Antiperiodic and anti-inflammatory</td>
<td>Choudhary 2019</td>
</tr>
<tr>
<td>A. dubius</td>
<td>Antibacterial activity</td>
<td>Firdhouse and Lalitha 2013</td>
</tr>
<tr>
<td>Azadirachta indica</td>
<td>Anti-complimentary activity</td>
<td>Tripathi and Lalitha 2009</td>
</tr>
<tr>
<td>Ficus carica</td>
<td>Anticancer and anti-diabetic</td>
<td>Badgujar et al 2014</td>
</tr>
<tr>
<td>Citrus sinensis</td>
<td>Act as sources of antioxidants and chemical exfoliants in cosmetics</td>
<td>Bown. 1995</td>
</tr>
<tr>
<td>Eclipta prostrate</td>
<td>Anti-complimentary activity</td>
<td>Li N., et al. 2018</td>
</tr>
<tr>
<td>Vitex negundo</td>
<td>Antimicrobial activity against gram +ve and gram -ve bacteria</td>
<td>Zargar et al 2011</td>
</tr>
<tr>
<td>Coccenina indica</td>
<td>Activity against drug resistant pathogens</td>
<td>Naygan et al (2018)</td>
</tr>
<tr>
<td>Pinus merkusii</td>
<td>Immunostimulatory activity</td>
<td>Sudjarwo et al 2018</td>
</tr>
<tr>
<td>Rumex acetosa</td>
<td>Antioxidant activity, antibacterial activity</td>
<td>Kota et al 2017</td>
</tr>
<tr>
<td>Mangnolia officinalis</td>
<td>Vascular administration of nanosuspension of anticancer compound honokiol</td>
<td>Zheng et al 2010</td>
</tr>
<tr>
<td>Cuscutta chenensis</td>
<td>Hepatoprotective and antioxidant activity</td>
<td>Yen et al 2008</td>
</tr>
<tr>
<td>Ficus religiosa</td>
<td>Effective against lung, liver, cervical and colon cancer</td>
<td>Nakkala et al 2017</td>
</tr>
<tr>
<td>Jaman yunnnonensis</td>
<td>Treatment of liver cancer.</td>
<td>Xia et al 2016</td>
</tr>
</tbody>
</table>

REFERENCES


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