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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, antidiabetic, 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 *Aoalypha 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. Naygan *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 sinavsis* 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 *Cantella 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 procua* 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

Nanoparticles synthesized from *Taxus baccata*, *Curculigo orchioides*, *piper nigrum, Ailanthus excelsa, lonicera hypoglauca, panasc ginseng,* fruit of *ficus caria,* leaves of *menyha arvensis, Coriandrum sativum* have been reported to be effective in treatment of breast cancer (Banerjee *et al* 2017, Kajaniet *et al* 2014, Kayalvizhiet 2016, Krishna *et al* 2016, Jang *et al* 2016, Castro-Aceitune *et al* 2016, Justin Packia *et al* 2017, Yinmathi *et al* 2015, Satish kumar *et al* 2016. In a study conducted by Nakkala *et al* 2017 nanoparticles prepared from leaves of *Ficus religiosa* were reported to be effective against lung, liver, cervical and colon cancer. Xia *et al* 2016 also reported activity of nanoparticles synthesized from leaves of *Jamun yunnonensis* leaves in treatment of liver cancer.

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

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

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