INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA):IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

A Review On Nanotechnology In Herbal Medicine

Vaibhav V. Narwade*, M. D. Game, Sanket G. Kadam

Department of Quality Assurance, Vidya Bharti college of Pharmacy, Amravati.

ARTICLE INFO

Received: 02 April 2024
Accepted: 06 April 2024
Published: 07 April 2024

Keywords:
Microneedles, transdermal drug delivery, stratum corneum, types, fabrication techniques, applications, evaluation, characterization, patents.

DOI:
10.5281/zenodo.10937867

ABSTRACT

Herbal medicines have been widely used around the world since ancient times. The advancement of phytochemical and phytopharmacological sciences has enabled elucidation of the composition and biological activities of several medicinal plant products. The effectiveness of many species of medicinal plants depends on the supply of active compounds. Most of the biologically active constituents of extracts, such as flavonoids, tannins, and terpenoids, are highly soluble in water, but have low absorption, because they are unable to cross the lipid membranes of the cells, have excessively high molecular size, or are poorly absorbed, resulting in loss of bioavailability and efficacy. Some extracts are not used clinically because of these obstacles. It has been widely proposed to combine herbal medicine with nanotechnology, because nanostructured systems might be able to potentiate the action of plant extracts, reducing the required dose and side effects, and improving activity. Nanosystems can deliver the active constituent at a sufficient concentration during the entire treatment period, directing it to the desired site of action. Conventional treatments do not meet these requirements. The purpose of this study is to review nanotechnology based drug delivery systems and herbal medicines. This study explores the synergistic potential of nanotechnology and herbal drugs in the field of disease therapy. By combining the targeted delivery capabilities of nanocarriers with the therapeutic properties of herbal compounds, this approach aims to enhance treatment efficacy while minimizing side effects. The investigation involves the development of novel nanocarrier systems for herbal drug encapsulation and delivery to target cells. The study further evaluates the bioavailability, cytotoxicity, and overall therapeutic impact of this integrated approach, offering promising insights into a potentially potent and more sustainable treatment strategy.

INTRODUCTION

The WHO has recently defined traditional medicine (including herbal drugs) as comprising therapeutic practices that have been in existence, often for hundreds of years, before the development and spread of modern medicine and

***Corresponding Author:** Vaibhav V. Narwade
Address: *Department of Quality Assurance, Vidya Bharti college of Pharmacy, Amravati.*
Email : vaibhavnarwadepatil07@gmail.com
Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

are still in use today. Traditional medicine is the synthesis of therapeutic experience of generations of practicing physicians of indigenous system of medicine. Traditional preparations comprise medicinal plants, minerals and organic matter etc. Herbal drugs constitute only those traditional medicines which primarily use medicinal plant preparations for therapy. The earliest recorded evidence of their use in Indian, Chinese, Egyptian, Greek, Roman and Syrian texts dates back to about 5000 years. The classical Indian texts includeRigveda, Atharvaveda, Charak Samhita and Sushruta Samhita. The junction of the rich knowledge from different traditional systems of medicine can lead to new avenues in herbal drug discovery process[1]. The combination of herbal medicine with the nanotechnology is nowadays has becoming a great strategy for delivering the drug. Using modern techniques, Herbal drug could provide novel molecular probes. It is now possible to explore the mechanism of action of herbal drugs in terms of current concept of molecular pharmacology. Nanotechnology is defined as applied science and technology which aims to develop devices and dosage forms in the range of 1 to 100 nm. The applications of nanotechnology for treatment, diagnosis, monitoring, and control of biological systems have recently been referred to as nanomedicine. Nanosystems output is the active constituent at a sufficient concentration during the entire treatment period, directing it to the desired site of action. Conventional treatments fail to complete these requirements. The purpose of this study is to review nanotechnology-based drug delivery systems. Most of the biologically active constituents of extracts, such as flavonoids, tannins, and terpenoids, are highly water-soluble, but demonstrate a low absorption, because they are unable to cross lipid membranes, have high molecular sizes, and demonstrate poor absorption, resulting in loss of bioavailability and efficacy. Some studies have shown that herbal medicines have good activity in assays in vitro, which are not reproducible in experiments in vivo[2]. Furthermore, some essential elements like (microsphere and liposomes) properties. E.g. Although the majority of this work includes the use of microspheres, liposomes and gels are limited to the delivery of macromolecules (e.g., insulin and growth hormone)[3]. Several nanotechnological strategies, such as polymeric nanoparticles, solid lipid nanoparticles (SLNs), liquid crystal (LC) systems, precursors systems for liquid crystals (PSLCs), liposomes, and micro emulsions, have attempted to break this barrier; they allow substances with different properties to be used in the same formulation, and may even change a substance's properties and behaviour in a biological environment. These technological discoveries have revolutionized process of drug delivery. The new drug delivery systems have the ability not only to increase the effectiveness of active components, but also to reintroduce other components that could help in the drug delivery process and ultimately the enhancement of drug efficacy as well as its effectiveness.

History and development

Since ancient days, natural products, including plants, have been the basis of treatment of human diseases. The basis of concept of modern medicine development remains rooted in traditional medicine and therapies[4,5]. In different parts of the world like ancient China, Egypt, Africa, America, and India, plants had been used for medicinal purposes long before recorded history. Chemical analysis first became available in the early 19 century which started the extraction and modification of herbal ingredients[4,6]. For a long time, herbal medicines were not considered for development as novel formulations owing to lack of scientific justification and processing difficulties, such as standardization, extraction, and identification of individual drug components in complex polyherbal systems. However, modern

phytopharmaceuticals research solves the scientific needs for herbal medicines as in modern medicine, which gives way for developing novel formulations such as nanoparticles, micro-emulsions, matrix systems, solid dispersions, liposomes, SLNs, and so on. Nanomicellar system[7], nanotubes[8], and colloidal nanogels have been developed for curcumin to be used alone as well as in combination with other chemotherapeutic agents like paclitaxel[9].

Need for novel drug delivery system "nano-carriers" for "herbal remedies"

Before reaching to the blood, many constituents of the herbal drugs will be smashed in the highly acidic pH of the stomach and other constituents might be metabolized by the liver. Resultant, the optimum quantity of the herbal drugs may not reach the blood. If the drug does not reach in the optimum amount to the infected region at "minimum effective level," then there will be no means to show the therapeutic effect of the drug. Nanocarriers applying to herbal remedies will carry optimum amount of the drug to their site of action bypassing all the barriers such as acidic pH of stomach, liver metabolism and increase the prolonged circulation of the drug into the blood due to their small size[9,10].

Advantages of herbal nanoparticle delivery system

- They appear to be able to deliver high concentrations of drugs to disease sites because of their unique size and high loading capacities[9].
- Deliver the drug in the small particle size that enhances the entire surface area of the drugs allocating quicker dissolution in the blood. The concentration seems to persist at the sites for the longer periods[9].
- Shows EPR (enhanced permeation and retention) effect, i.e., enhanced permeation through the barriers because of the small size and retention due to poor lymphatic drainage such in tumor[9].
- Exhibits passive targeting to the disease site of action without the addition of any particular ligand moiety[9].
- Decrease in the side effects[9].
- Decrease in the dose of the drug formulation[9].

Types of Nanoparticles

a. Polymeric nanoparticles
b. Solid lipid nanoparticles
c. Magnetic nanoparticles
d. Metal and inorganic nanoparticles
e. Quantum dots
f. Polymeric micelles
g. Phospholipids micelles
h. Collidal nano-liposomes
i. Dendrimers
j. Nano crystals.
k. Quantum dots.
l. Nanospere.
m. Nanocapsule.

Table 1: List Of Some Herbal Drugs Used In Cancer Therapy

Sr.no	Common name	Botanical Name	Active Constituent	part Used	Family	Reference
1	Rauwolfia	Rauwolfia Serpentin a	Reserpine	Root	Apocynaceae	12
2	Pirorhiza	PicrorhizaKurroa	Picroside I, II, III	Rhizome, Root	Scrophulariaceae	12
3	Liquorice	GlycyrrhizaGlabra	Glycyrrhizine	Rhizome, Root	Fabaceae	12

4	Meadow Saffron Corm	Colchicum Luteum	Colchicine	Corm	Liliaceae	12
5	Cinchona	Cinchona Of icinalis	Cinchonine	Bark	Rubiaceae	12
6	Pacific Yew	TaxusBrevifolia	Paclitaxel	Bark, Leaves	Taxaceae	12
7	Indian Ipecac	Tyloporaindica	Emetine, Cephaeline	Root, Leaf	Asclepiadaceae	11,12
8	Tobacco	Nicotianatabacum	Nicotine	Plant leaves	Solanaceae	11
9	Mint	Mimosa pudica	Vitamin C	Whole plant	Mimosaceae	11
10	Lemon	Citrus medica	Citral, Limonene	Root	Rutaceae	11, 6
11	Senna	Cassia senna	Sennoside A, Sennoside B	Leaves	Caesalpinaceae	11, 6
12	Indian Aloe	Aloe barbadensis	Aloin or barbaloin and Isobarbaloin	Leaves	Liliaceae	11, 6
13	Amla	Emblica of icinalis	Polyphenols, flavones, tann	fruit	Euphorbiaceae	7
14	Turmeric	Curcuma longa	Curcumin	Rhizome	Zingibaracae	6

CONCLUSION:-

The integration of nanotechnology with herbal medicines presents a promising approach to overcome challenges associated with the bioavailability and efficacy of medicinal plant products. This study emphasizes the potential of nanosystems in delivering active constituents at targeted concentrations throughout the treatment period, particularly in the context of cancer therapy. By developing novel nanocarrier systems, this synergistic approach aims to enhance treatment efficacy while minimizing side effects, providing valuable insights for a more sustainable and potent cancer treatment strategy. The historical roots of herbal medicines, combined with advancements in nanotechnology, showcase the evolution of traditional practices into innovative and scientifically justified formulations, paving the way for future developments in drug delivery system. This approach addresses challenges like poor bioavailability and efficacy of herbal extracts by utilizing nanocarrier systems. The review underscores the historical significance of herbal medicines and the recent advancements in nanotechnology, emphasizing the potential synergy between the two in drug delivery systems. The advantages of herbal nanoparticle delivery systems, such as high drug concentration at disease sites and reduced side effects, make them a compelling option for improving treatment. The comprehensive exploration of various nanocarrier types and a detailed list of herbal drugs used in cancer therapy further contribute to the understanding of this innovative approach. Overall, the study provides insights into a potentially potent and more sustainable treatment strategy through the combination of nanotechnology and herbal drugs.

REFERENCES

1. Pal SK, Shukla Y (2003) Herbal Medicine: Current Status and the Future Asian Pacific. J Cancer Prev4: 281-288.
2. Bonifácio BV, Silva PB, Ramos MA, Negri KM, Bauab TM (2014), Nanotechnology-based drug delivery systems and herbal medicines: a review. Int J Nanomedicine 9: 1-15
3. Türker S, Onur E, Ozer Y (2004) Nasal route and drug delivery systems. Pharm World Sci 26:137-142
4. Sharma AT, Mitkare SS, Moon RS. Multicomponent herbal therapy: A review. Int J Pharm Sci Rev Res. 2011;6:185–7.
5. Patwardhan B, Vaidya AD, Chorghade M. Ayurveda and natural products drug discovery. Curr Sci. 2004;86:789.
6. Currier SJ, Johnston PD, Gorelick KJ. Complementary and Alternative Medicine-Herbal Medicines. Sci Med. 2000;7:40–3
7. Bisht S, Feldmann G, Soni S, Ravi R, Karikar C, Maitra A, et al. Polymeric nanoparticle-encapsulated curcumin ("nanocurcumin"): A novel strategy for human cancer therapy. J Nanobio. 2007;5:1–18.
8. Zheng L, Song JF. Curcumin multi-wall carbon nanotubes modified glassy carbon electrode and its electrocatalytic activity towards oxidation of hydrazine. Sens Actuators B Chem. 2009;135:650–5.
9. Yadav D, Suri S, Choudhary AA, Sikender M, Hemant, Beg NM, et al. Novel approach: Herbal remedies and natural products in pharmaceutical science as nano drug delivery systems. Int J Pharm Tech. 2011;3:3092–116
10. Bairwa NK, Sethiya NK, Mishra SH. Protective effect of stem bark of Ceiba pentandra Linn. against Paracetamolinduced hepatotoxicity in Rats. Pharmacognosy Res. 2010;2:26–30.
11. Maurya U, Srivastava S: "Traditional Indian herbal medicine used as antipyretic, antiulcer, anti-diabetic and anticancer: A review." IJRPC 2011; 1.4: 1152-1159.
12. Saroja J, Vidhu A: A Practical Book of Pharmacognosy. Frank Bros. & Co. (Publishers) Ltd. First Edition 2009; Page no. 77, 264, 104, 146, 157, 268, 257, 227, 135, 115, 194, 80, 302, 151,155.
13. Mamillapalli V, Malyada Atmakuri A, Khantamneni P (2016) Nanoparticles for Herbal Extracts Asian Journal of Pharmaceutics10:55-59.(https://www.asiapharmaceutics.info/index.php/ajp/article/view/623)
14. Muhamad N, Plengsuriyakarn T, Na-Bangchang K (2018) Application of active targeting nanoparticle delivery system for chemotherapeutic drugs and traditional/herbal medicines in cancer therapy: a systematic review Int J Nanomedicine 3: 3921-3935. (https://www.ncbi.nlm.nih.gov/pubmed/30013345)
15. Aliosmanoglu A, Basaran L (2012) Nanotechnology in Cancer Treatment J Nanomed Biotherapeut Discov 2: 2-4. (https://www.longdom.org/open-access/nanotechnology-in-cancer-treatment-2155-X.1000107.pdf)
16. Krishnamurthy S, Vaiyapuri R, Zhang L, Chan JM (2015) Lipid-coated polymeric nanoparticles for cancer drug delivery Biomaterials Science 3: 923-936.(https://pubs.rsc.org/en/content/articlelanding/2015/bm/c4bm00427b#!divAbstract)
17. Lee KS, Chung HC, Im SA, Park YH, Kim CS, et al. (2007) Multicenter phase II trial of Genexol-PM, a Cremophor-free, polymeric micelle formulation of paclitaxel, in patients with metastatic breast cancer, Breast Cancer Res Treat 108: 241-250. (https://www.ncbi.nlm.nih.gov/pubmed/17476588)

18. Jaiswal YS, L. Williams L (2016) A glimpse of Ayurveda The forgotten history and principles of Indian traditional medicine. J Tradit Complement Med 7: 50-53. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5198827/)
19. Ioana Lungu I, Mihai Grumezescu A, Volceanov A, Ecaterina Andronescu E (2019)Nanobiomaterials Used in Cancer Therapy: An Up-To-Date Overview Molecules 24: 3547.(https://www.mdpi.com/1420-3049/24/19/3547)
20. Heath JR, Davis ME (2008) Nanotechnology and Cancer. AnnuRev Med 59: 251-265.(https://www.ncbi.nlm.nih.gov/pubmed/17937588)
21. Amreddy N , Babu A, Muralidharan R (2018) Recent Advances in Nanoparticle-Based Cancer Drug and Gene Adv Cancer Res 137: 115-170.(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6550462/)
22. Yadav D, Suri S, Choudhary AA, Sikender M, Hemant, Beg NM, et al. Novel approach: Herbal remedies and natural products in pharmaceutical science as nano drug delivery systems. Int J Pharm Tech. 2011;3:3092–116
23. Robinson JR. Introduction: semi-solid formulations for oral drug delivery. Bull Tech Gattefosse. 1996;89:11–3.
24. Souza-Moreira TM, Salgado HRN, Pietro RCLR. O Brasil no contexto de controle de qualidade de plantas medicinais [Brazil in the context of quality control of medicinal plants] Rev Bras Farmacog. 2010;20(3):432–440. Portuguese.
25. Moulari B, Lboutounne H, Chaumont J, Guillaume Y, Millet J, Pellequer Y. Potentiation of the bacterial activity of Harungana madagascariensis Lam. Ex Poir. (Hypericaceae) leaf extract against oral bacteria using poly (D,L-lactide-coglycolide) nanoparticles: in vitro study. Acta Odontol Scand. 2006;64(3):153–158.
26. Saroja J, Vidhu A: A Practical Book of Pharmacognosy. Frank Bros. andC(Publishers)Ltd. First Edition 2009; Page no. 77, 264, 104, 146, 157, 268, 257, 227, 135, 115, 194, 80, 302, 151,155.
27. NarahM, Kalita JC and Kotoky J: Medicinal plant withpotential anticancer activity : A Review. IRJP2012; 3 (6):

HOW TO CITE: Vaibhav V. Narwade, M. D. Game, Sanket G. Kadam, A Review On Nanotechnology In Herbal Medicine, Int. J. of Pharm. Sci., 2024, Vol 2, Issue 4, 411-416. https://doi.org/10.5281/zenodo.10937867