



Review On Herbal Nanoparticles Against Cancer

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ABSTRACT:

Herbal medicines, since ancient times and identified by doctors and patients for their betterment they are of therapeutic importance as they have less adverse effects than modern drugs. Reactions of chemotherapy are a major concern in the treatment of cancer and hence the use of the herb is to find effective solutions. Treatment with lower side effects. Nanoparticulate formulations like liposomes, polymeric nanoparticles, solid lipid nanoparticles and microemulsions present the potential to effectively deliver herbal medicines. The main reason behind the improvement of alternative drug delivery is to increase efficacy and safety of drugs delivery and provides greater useful to the patient. The use of medicinal plants for the purpose of preparing nanoparticles has paved the way for a drug targeting particularly damaged site of the tumor. Nano sized drug delivery system of herbal medicines there is a probable future for increasing the activity and overcoming the problems allied with plant medicines. Therefore, integration of nanocarriers in the form of NDDS into the traditional medical system is necessary for more conflict chronic diseases. Some studies revealed that the several nanoformulations are from a number of natural products. This review discusses the nano drug delivery system, advantages, disadvantages, properties, types of nanoparticles, methods of preparations and the role of herbal plants and constituents nanoparticles against cancer.

Keywords: Herbal drugs, Nanoparticles, Novel drug delivery system, Medicinal plant, anticancer activity.

INTRODUCTION:

Herbal remedies have been used for many years all over the world; herbal medications are especially popular in India. The use of herbal medicines in recent decades has significant growth in evident from the growing global market of herbal medicines. An herbal formulation, which is one of the major sections of traditional system of medicine, contributes immensely to ones positive health person. Cancer is caused by the irregular or uncontrolled growth of cells in a body. When cancer cells divide and reproduce, they form tumors, which are collections of cancer cells. Tumors cause many of the symptoms of cancer by inhibiting, compressing, and eliminating non-cancerous cells and tissues in the surrounding area. Colloidal systems with particle sizes ranging from 10 to 1000 nm are referred to be nanoparticles. Nanoparticles are considered an important novel drug delivery system. Nanoparticles can be used to individually target an herbal medicine that improves selectivity, efficiency and safety of drug delivery thereby reducing dose and increasing patient compliances.^{1,2,3}

Cancer cell targeting:

The term "cancer" is a broad one. It's a disease that occurs when biological alterations lead to unregulated cell growth and division. Some cancers cause cells to grow and divide quickly, while others cause cells to grow and divide slowly. Cancer cells can spread through the blood to other parts of the body and lymphatic system. There are different types of cancers, for examples, colon, liver, breast cancers. Development of all types of cancer starts in cells. To keep the body healthy, cells divide and expand in a controlled manner to produce additional cells. Damaged cells are replaced by new ones once they experience apoptosis (programmed cell death). However, this methodical approach can occasionally go away. Normal cell growth and division are affected by mutation (changes in genetic material). When it happens, instead of dying, new cells are made; although the body does they are not needed. These additional cells can further form a mass of tissue is called a tumor. Tumor can be benign or malignant.³

Benign tumor (non cancerous):

A benign tumor is a group of cells that lack the ability to invade or metastasize to neighboring tissue. Benign tumors do not spread to other parts of the body when they are contained within cells.¹

Malignant tumor (cancerous):

These tumors' cells have the ability to infiltrate adjacent tissues and spread to other regions of the body.¹

Nanoparticles:

Nanoparticles are particles between 1 and 100 nm in size. A particle is a small entity that functions as a single unit in terms of transport and attributes in nanotechnology.

Role of nanoparticles:

- To deliver the drug into smaller particle sizes that increase rapidly allocating entire surface area of drugs dissolve in blood.
- To deliver the drugs to the site of action.
- The drug delivery system is targeted in a specific way.
- Penetration of the drugs into epithelial and endothelial barriers.⁴

Advantages of nanoparticles:

- Nanoparticles increase stability of drugs or proteins against enzymatic degradation.
- A nanoparticles reduces the toxicity of liver.
- They offer an effective improvement over oral and intravenous methods of administration in terms of efficiency and effectiveness.
- Nanoparticles are smaller than microspheres and liposomes, allowing them to travel through the sinusoidal spaces in the bone marrow and spleen more easily than other systems with extended circulation times.⁵

Disadvantages of nanoparticles:

- High immunogenicity
- Possibility of poor targeting
- Long and expensive to spend.
- High surface area and energy, they have high aggregation in biological system.⁵

Types of Nanoparticles:

1. Carbon based nanoparticles
2. Metal nanoparticles
3. Ceramics nanoparticles
4. Semiconductor nanoparticles
5. Polymeric nanoparticles
6. Lipid based nanoparticles

Methods of Preparation of Nanoparticles:

1. Salting out method
2. High pressure homogenization method
3. Solvent emulsification-diffusion method

Salting Out Method:

The solubility of non-electrolytes in water is reduced in this approach when an electrolyte is added. And this strategy is based on the solubility phenomena. The salting out method using electrolytes is used to separate acetone from aqueous solution because of its water soluble characteristics. The acetone diffusion by droplets is the quickest method. This diffusion that occurs upon dilution with additional water can induce interaction disturbance due to polymer aggregation in the form of nanoparticles. [figure1]^{5,6}

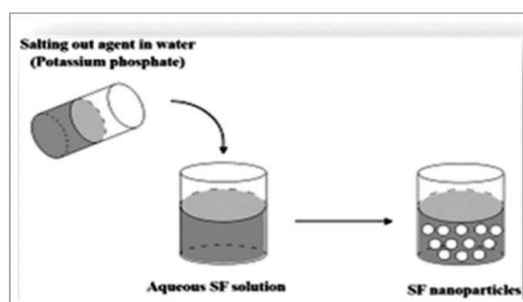
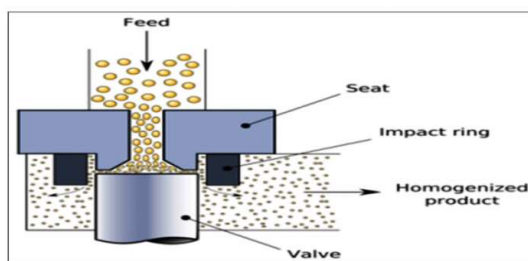


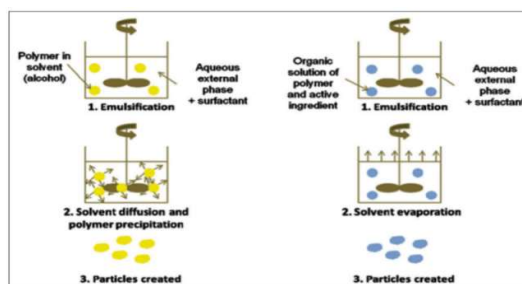
Figure 1: Salting out method⁵

High Pressure Homogenization Method:

In this method, lipids are pushed under high pressure (100-2000 bar) through a very high shear stress, resulting in the dissolution of particles up to submicrometers or nanometer range. High pressure homogenization method is a very reliable and powerful technique for large scale production of nanostructure lipid drugs, lipid carriers, conjugates, solid lipid nanoparticles and parenteral emulsions. [figure2]^{5,6,7}

Figure 2: High pressure homogenization method ⁵**Solvent Emulsification Diffusion Method:**

This method involves preparing the o/w emulsion with an oil phase containing the polymer and oil in an organic solvent that emulsifies with an aqueous phase containing stabilizers in a high shear mixer, then adding water to reduce the diffusion of the organic solvent, resulting in nanoparticles manufacturing.[figure3] ^{5,6,8}

Figure 3: Solvent emulsification diffusion method ⁵**Herbs used against cancer: ⁹**

1. Curcuma longa (curcumin)
2. Azadirachta indica
3. Syzygium aromaticum (clove)
4. Origanum vulgare
5. Polygala senega
6. Panax ginseng
7. Nepta deflersiana
8. Apricot
9. Cascara
10. Cephalotaxus

Nanoparticles involved in the development of various herbal formulations:**Table no 1: Polymeric nanoparticles of herbal formulations** ^{10, 11, 12}

Herbal medicine	Chemical Classification	Pharmacological Activity
Curcumin	Natural polyphenol isolated from the root of <i>Curcuma longa</i>	Antitumor, antiplatelet aggregation, antioxidant
Vinca	Vinca alkaloid vincristine, vinblastine	Anticancer
Catechins	Phenolic metabolites derived from tea plant <i>Camellia sinensis</i>	Anticarcinogenic, antiviral, antibacterial, anti-inflammatory
Camptothecin	Cytotoxic quinoline alkaloid isolated from bark and stem of oriental tree <i>Camptotheca acuminata</i>	Treatment of gastric, rectum, bladder, colon, lung and breast cancer

Table no 2: Solid lipid nanoparticles herbal formulation ^{10, 12, 13}

Herbal medicine	Chemical classification	Pharmacological activity
Curcuminoids	Natural poly phenol isolated from the root of <i>Curcuma longa</i>	Antitumor, antioxidant
Triptolide	Diterpenoid triepoxide obtained from Chinese medicine <i>Tripterygium wilfordii hook F</i>	Antineoplastic activity, treatment of leukemia
Podophyllotoxin	Resin mixture obtained from dried roots of <i>Podophyllum peltatum</i>	Anticancer activity

Table no 3: liposome herbal formulation^{10, 12, 13}

Herbal medicine	Chemical classification	Pharmacological activity
Catechins	Phenolic metabolites derived from tea plant <i>camellia sinensis</i>	Anticarcinogenic, chemo preventive, antidiabetic, antiviral activity
Curcumin	Natural poly phenol isolated from the root of <i>Curcuma longa</i>	Antioxidant, antiplatelet aggregation. Antitumor
Silymarin	Flavonoid glycoside obtained from dried fruits of <i>Silybus marianum</i>	Hepatoprotective agent

Curcuma longa:

Curcumin, a natural chemical isolated from *Curcuma longa* L., is considered one of the most studied chemopreventive medicines. Curcumin can decrease the development of certain tumor cells and prevent carcinogen. Curcumin anticancer efficacy is primarily mediated by causing apoptosis and limiting tumor proliferation and invasion through the suppression of a range of cellular mechanisms. In Phase I and Phase II clinical trials, curcumin was determined to be quite safe, and it may have therapeutic efficacy. It discusses the general features of curcumin and as well as possible anticancer benefits, including evidence of antitumor activity in vitro, clinical techniques to overcome low curcumin levels in vivo, and absorption.^{14, 15}

Azadirachta indica:

The extract of *Azadirachta indica* extracts possess useful ability to remove cancerous phenotype. Chemopreventive qualities are discovered in Neem compounds present in the bark, flowers, leaves, and seed oil. As well as apoptotic activity, immunomodulatory effects, and the ability to induce p-53 independent apoptosis. Nanoparticles and crude clove extracts were used in the treatment of cancer cells. It is more successful in cancer cells treatment when nanoparticles are used in conjunction with clove extract. This page discusses the general qualities of herbs as well as their possible anti-cancer effects, including evidence of antitumor activity.^{16, 17, 18}

Syzygium aromaticum:

Clove and nanoparticles have anticancer activity but they don't get significant response to cancer cells when treated alone. In combination with clove extracts, fluorescent magnetic submicronic polymer nanoparticles promote cancer cell death. According to morphological and quantitative data, the combination of FMSP nanoparticles with crude clove extracts is more effective in treating cancer cells, and the treatment of nanoparticles with clove extract has excellent cancer curing characteristics.^{1, 16, 17}

Origanum vulgare:

Origanum vulgare used against human adenocarcinoma of the breast [MCF7] and adenocarcinoma of the colon in humans [HT29]. The anti-lung cancer benefits of *Origanum vulgare* aqueous extract were examined, and biosynthesized nanoparticles were found to be effective in suppressing human pathogens in single dosage dependent approaches. Some species have Antiproliferative activity screened to assess their anticarcinoma activity against the cell line.^{1, 16, 17}

Nano herbal formulations against cancer:⁵

The Nano pharmaceutical delivery systems help better bioavailability, reduce side effects and toxicity. Some marketed Nano herbal medicines are described as below:

- 1) Artemisinin nanocapsule:
Formulation- Artemisinin nanocapsule
Active ingredient- Artemisinin
Use- Anticancer
Application of nanostructure formulations- Sustained drug release
- 2) Berberine loaded nanoparticles
Formulation- Berberine loaded nanoparticles
Active ingredient- Berberine
Use- Anticancer
Application of nanostructure formulation- Sustained drug release
- 3) Taxel loaded nanoparticles
Formulation-Taxel loaded nanoparticles
Active ingredient- Taxel
Use- anticancer
Application of nanostructure formulation- Enhance bioavailability

CONCLUSION:

Herbal medicines getting more attention recently because of their potential for healing almost all diseases. The nanotechnology in combination with herbal medicines may provide the useful tool designing the future herbal medicines with enhanced bioavailability and less toxicity. In present review studied the plant and parts of plant or their product have been reported utilized as anticancer. Nanoparticles synthesized by using many different ingredients and different plants extracts a huge potential for cancer treatment and diagnosis especially metastasis cancer. This review has also shown that herbs have been prepared as nanoparticles not only to enhance solubility and bioavailability of soluble herbs but to improve tissue distribution to obtain sustained delivery and the nanoparticles play the vital role.

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