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Drug Delivery System in Nano Greens

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ABSTRACT

Herbal medicines have been widely used all over the world since ancient times and have been recognized by physicians and patients for their better therapeutic value as they have fewer adverse effects as compared with modern medicines. Herbal therapeutics can be achieved by Drug Delivery systems. This herbal treatment helps to increase the therapeutic value by reduce the toxicity and side effects of drugs at the same time it also increase the bioavailability. In this approach Nanotechnology plays a great role and the use of nanotechnology in medicine and more specifically drug delivery is set to spread rapidly. Nano herbal drug delivery systems have a potential future for enhancing the activity and overcoming the problems associated by medicinal plants. So the nanocarriers help to treat the dangerous diseases like cancer, Diabetes etc.

Keywords: Herbal Drugs, Nano Technology, Nano Carriers, Drug Delivery Systems.

1. Introduction

Herbal medicine is also called phyto medicine using a plant's seeds, berries, roots, leaves, bark, or flowers for medicinal purposes. Herbalism has a long tradition of use outside of conventional medicine. It is becoming more main stream as improvements in analysis and quality control along with advances in clinical research and the value of herbal medicine in the treating and preventing disease.

The medicinal plants and its uses predate written human history. Many of the herbs and spices used by humans to season food also yield useful medicinal compounds [1]. The use of herbs and spices in cuisine developed in part as a response to the threat of food-borne pathogens. In tropical climates where pathogens are the most abundant, recipes are the most highly spiced. Further, the spices with the most potent antimicrobial activity tend to be selected [2]. In all cultures vegetables are spiced less than meat, presumably because they are more resistant to spoilage [3]. Many of the common weeds that populate human settlements also have medicinal properties [4].

Many of the pharmaceuticals currently available have a long history of use as herbal remedies, including opium, aspirin, digitalis, and quinine. The World Health Organization (WHO) estimates that 80 percent of the populations of some Asian and African countries presently use herbal medicine for some aspect of primary health care [5]. In comparison, herbal medicines can be grown from seed or gathered from nature for little or no cost than pharmaceuticals. The use of, and search for, drugs and dietary supplements derived from plants have accelerated in recent years. Pharmacologists, microbiologists, botanists, and natural-products chemists are combing the Earth for phytochemicals and leads that could be developed for treatment of various diseases [6]. Among the 120 active compounds currently isolated from the higher plants and widely used in modern medicine today, 80 percent show a positive correlation between their modern therapeutic use and the traditional use of the plants from which they are derived [7]. More than two thirds of the world's plant species - at least 35,000 of which are estimated to have medicinal value - come from the developing countries. At least 7,000 medical compounds in the modern pharmacopoeia are derived from plants [8]. In many medicinal and aromatic plants (MAPs) significant variations of plants characteristics have been ascertained with varying soil traits, and the selective recovery and subsequent release in food of certain elements have been demonstrated. Great attention must be paid to choose soil and cropping strategies, to obtain satisfactory yields of high quality and best-priced products, respecting their safety and nutritional value [9].

Plants produce chemical compounds as part of their normal metabolic activities. These phytochemicals are divided into (1) primary metabolites such as sugars and fats, which are found in all plants; and (2) secondary metabolites—compounds which are found in a smaller range of plants, serving a more specific function [10]. For example, some secondary metabolites are toxins used to deter predation and others are pheromones used to attract insects for pollination. It is these secondary metabolites and pigments that can have therapeutic actions in humans and which can be refined to produce drugs—examples are insulin from the roots of dahlias, quinine from the cinchona, morphine and codeine from the poppy, and digitoxin from the foxglove.

1.1 Nano Carriers

A nanocarrier is nanomaterial being used as a transport module for another substance, such as a drug. Commonly used nanocarriers include micelles, polymers, carbon-based materials, liposomes and other substances [11]. Nanocarriers are currently used in drug delivery and their unique characteristics demonstrate potential use in chemotherapy.

Nanocarriers include polymer conjugates, polymeric nanoparticles, lipid-based carriers, dendrimers, carbon nanotubes, and gold nanoparticles. Lipid-based carriers include both liposomes and micelles. Examples of gold nanoparticles are gold nanoshells and nanocages [12]. Different types of nanomaterial being used in nanocarriers allows for hydrophobic and hydrophilic drugs to be delivered throughout the body. Since the human body contains mostly water, the ability to deliver hydrophobic drugs effectively in humans is a major therapeutic benefit of nanocarriers [13]. Micelles are able to contain either hydrophilic or hydrophobic drugs depending on the orientation of the phospholipids molecules. Some nanocarriers contain nanotube arrays allowing them to contain both hydrophobic and hydrophilic drugs.

One potential problem with nanocarriers is unwanted toxicity from the type of nanomaterial being used. Inorganic nanomaterial can also be toxic to the human body if it accumulates in certain cell organelles [14] New research is being conducted to invent more effective, safer nanocarriers. Protein based nanocarriers show promise for use therapeutically since they occur naturally, and generally demonstrate less cytotoxicity than synthetic molecules [15].

Nanocarriers are being applied to their potential use in drug delivery, especially in chemotherapy. Since nanocarriers can be used to specifically target the small pores, lower pH's, and higher temperatures of tumors, they have the potential to lower the toxicity of many chemotherapy drugs [16]. Also, since almost 75% of anticancer drugs are hydrophobic, and therefore demonstrate difficulty in delivery inside human cells, the use of micelles to stabilize, and effectively mask the hydrophobic nature of hydrophobic drugs provides new possibilities for hydrophobic anticancer drugs.

1.2 Nano Pharmaceuticals

Nanopharmaceuticals offer the ability to detect diseases at much earlier stages and the diagnostic applications could build upon conventional procedures using nanoparticles. Nanopharmaceuticals represent an emerging field where the sizes of the drug particle or a therapeutic delivery system work at the nanoscale. In the pharmaceutical industry a long standing issue is the difficulty of delivering the appropriate dose of a particular active agent to specific disease site. Nanopharmaceuticals have enormous potential in addressing this failure of traditional therapeutics which offers site-specific targeting of active agents. Such precision targeting via nanopharmaceuticals reduces toxic systemic side effects, resulting in better patient compliance.

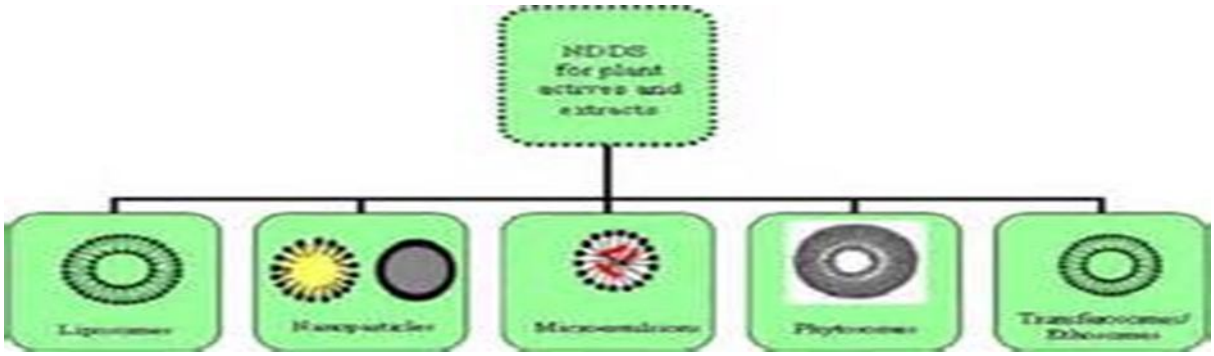

Fig 1: Applications of novel drug delivery system for herbal formulations

In today's world economy, a pharmaceutical industry faces enormous pressure to deliver high-quality products to patients while maintaining profitability. Therefore pharmaceutical companies are applying nanotechnology to enhance or supplement drug target discovery and drug formulation. Nanopharmaceutical reduces the cost of drug discovery, design and development and enhances the drug discovery process. This results in the improved Research and Development success rate which enables faster introduction of new, cost-effective products to the marketplace. For example, nanotechnology can be applied to current micro-array technologies, exponentially increasing the hit-rate for promising candidates/targets that can be screened. Inexpensive and higher-throughput DNA sequencers based on nanotechnology can reduce the time for both drug discovery and diagnostics.

Nanotechnology-on-a-chip is one more dimension of lab-on-a-chip technology. Magnetic nanoparticles, bound to a suitable antibody, are used to label specific molecules, structures or microorganisms. Gold nanoparticles tagged with short segments of DNA can be used for detection of genetic sequence in a sample. Multicolor optical coding for biological assays has been achieved by embedding different-sized quantum dots into polymeric microbeads. Nanopore technology for analysis of nucleic acids converts strings of nucleotides directly into electronic signatures. C-dots (Cornell dots) are the smallest silica-based nanoparticles

with the size <10 nm. The particles are infused with organic dye which will light up with fluorescence. Clinical trial is underway since 2011 to use the C-dots as diagnostic tool to assist surgeons to identify the location of tumor cells [17].

Nanotechnology is a new opportunities in implantable delivery systems, which are often preferable to the use of injectable drugs, because the latter frequently display first-order kinetics (the blood concentration goes up rapidly, but drops exponentially over time). This rapid rise may cause difficulties with toxicity, and drug efficacy can diminish as the drug concentration falls below the targeted range. The following are the different types of nano pharmaceuticals [18].

1.3 Polymeric Nanoparticles

- Solid lipid nanoparticles
- Magnetic nanoparticles
- Metal and inorganic nanoparticles
- Quantum dots
- Polymeric micelles
- Phospholipids micelles
- Colloidal nano-liposomes
- Dendrimers

Recently Curcumin has been widely acknowledged globally as a "wonder drug of the future" because of its great potential abilities to prevent and treat a wide spectrum of incurable and chronic diseases. However, the major problem limiting the exploitation of its potentially valuable therapeutic effects is its low bioavailability [19]. In practice, only very low or undetectable levels of curcumin can be achieved in blood by oral administration of curcumin. The low bioavailability of curcumin has been attributed to its very low aqueous solubility, tendency to degrade in the gastrointestinal tract in the physiological environment, high rate of metabolism, and rapid systemic elimination. The low bioavailability of curcumin has so far limited its medical use. It has been suggested that a person is required to consume large doses (about 12-20g/day) of curcumin in order to achieve its therapeutic effects on the human body [20]. That means one has to swallow 24 to 40 curcumin capsules of 500mg each. These doses are considered to be too high, and therefore, not feasible to be incorporated in clinical trials due to unbearable after-taste to the palate, possibility of giving rise to nauseatic feeling and perceived toxicity issues. Therefore, to achieve the maximum response of this potentially useful chemopreventive agent, a number of approaches such as the use of adjuvants like piperine, synthetic analogues, chelating of curcumin with metals, combination with other dietary agents etc.

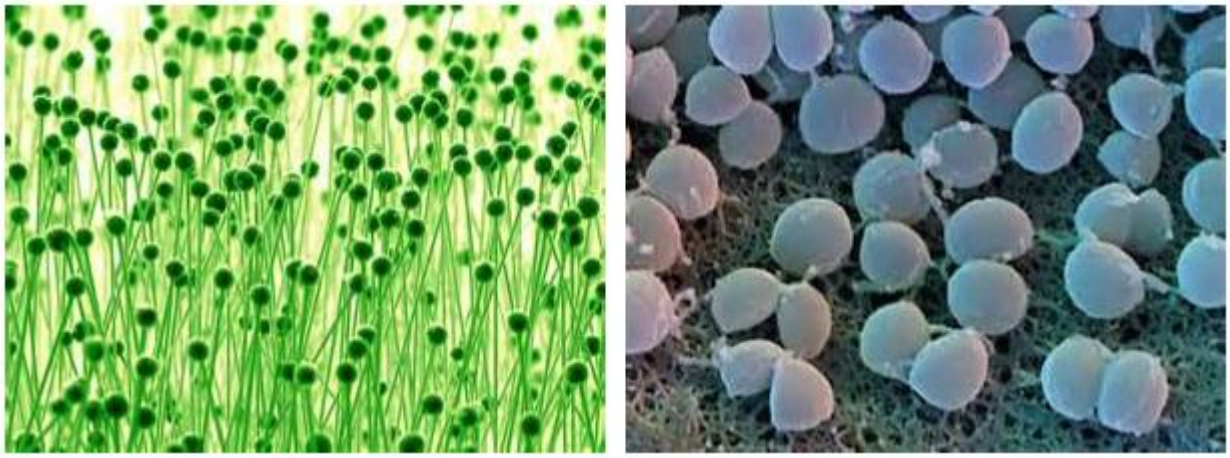

Fig 2 & 3: Nano particles

Nanoparticles are sub divided in to the compositions of many other sub particles such as carbon nanotubes from the Nanoparticles of carbon and the volcanic chemical Nanoparticles form the nano particle of lava etc. Toxicity of particles increases as they get smaller in size because when they are small they can easily floats in air and could cause serious disorder in living beings such as lungs cancer, head ache, blood pressure etc . Nano particles cannot be seen with the naked eyes then we can easily imagine the level of toxicity in every nanoparticle which is exposed to environment during the manufacturing process of nanotech applications. Nanoparticles have much larger area of the surface as compared to non-nano particles, its extreme compactness make it's highly flammable. Nano particles can easily penetrate in the skin of human beings and animas. Toxicology explores the reactivity and harmfulness of theses nano particles, it also provide us with the solutions to de toxicate the affected body. Nanotoxicology is studied in every field in which nanotechnology has application .it has further sub fields which are specialized in specific area such as electronics, medicine, computers, chemistry etc.

With the increasing development of nanotechnology and its extensively used applications, a wide range of nano-structured materials are now used in, pharmaceutics, cosmetics, biomedical products, and commercial industries. While nanoscale materials have more unique physicochemical properties than bulk materials, they also have unpredictable impacts on human health.

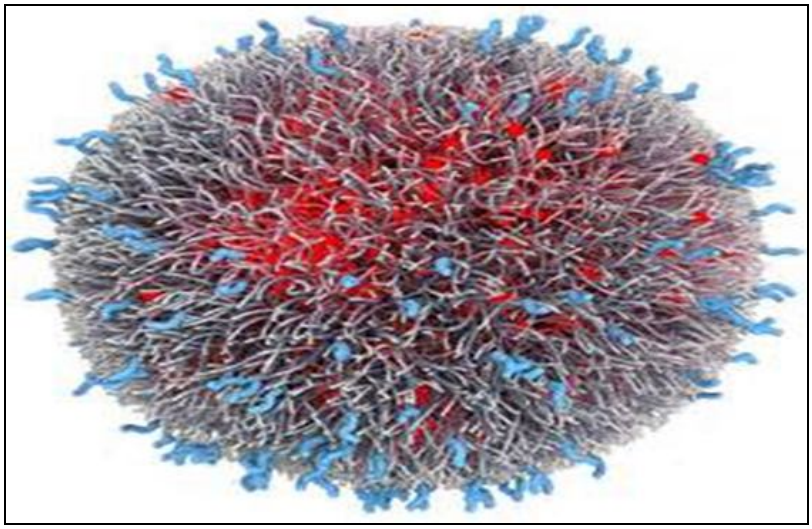

Fig 4: Targeted Nano particles show success in clinical trials

The entrance into human body and interaction of nanomaterials has generated severe scientific curiosity and mystery, attracting much attention and increasing concern from the public, nanomaterials-based industries, academic world, and governments throughout the world. Nanotoxicology is the first Art of study, which addresses the multidisciplinary area all those points, which everyone should understand. Nanotoxicology has uncovered the negative side of nanotechnology. It also measures the toxic effects and toxic potential of every nanoparticle.

2. Future Prospects of Nanomedicines

Herbal remedies and natural products research is more familiar throughout the world. The development of herbal remedies in the drug delivery system in a number of institutes is being carried out at basic and clinical trial levels. To improve the proper delivery systems at the sites or locations in the whole body in a particular dose will not compromise with the existing treatment. This would not only give relieve from side effects like toxicity and hypersensitive reactions but also will increase the patient's strength from inside is very much desirable. In the future, the concept of herbal nanoparticles for cancer drug delivery may also fascinate some potential research groups and potentially create attention-grabbing results.

3. Conclusion

Hence, using "herbal remedy" in the nanocarriers will increase its potential for the treatment of various chronic diseases and health benefits. Many successful examples were observed with the direction of nano research. Herbal remedies are also prosperous resources of advantageous compounds holding antioxidants and constituents that can be made use in purposeful foods. This type of research among the traditional "Herbal remedies" and newer approaches of modern drug delivery system, i.e., "Nanotechnology" has the attractive therapies to the pharmaceutical in near future that will enhance health of people. It is anticipated that the effectual and valuable relevance of the natural products and herbal remedies being applied with the nanocarrier will enhance the significance of existing drug delivery systems.

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