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# NANOTECHNOLOGY: RECENT TREAND FOR HERBAL MEDICINE

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## Abstract:

An inventive way to realize the full potential of herbal treatments is through the herbal nanotechnology. The use of nanotechnology in herbo-applications has considerable promise for improving the efficacy, efficiency, and targeting of herbal therapies. It has the ability to transform conventional herbal therapy and offer novel treatments for a variety of medical ailments.The use of nanoscale drug delivery systems for herbal remedies holds promise for improving their efficacy and resolving issues with plant-based remedies. The conventional medical system is crucial in combating the rise in chronic illnesses. The utilization of phytomedicine-based nanoformulations, plant-mediated manufacturing of metal nanoparticles to treat burn wound sepsis, and phyto-informatics models of the wound healing process to choose suitable nanotherapeutic agent. The overview for reducing of use also the production of dangerous chemicals that harm living organisms creates an opportunity for a beneficial partnership between plant sciences and nanotechnology.This collaboration has the potential to establish a mutually beneficial relationship between these two fields.The topic of nanotechnology is one that is quickly developing and has enormous potential benefits for industry, medicine, and cosmetics.The development of nanoherbal medications by nanotechnology will bring forth a new era in the study of herbal drug discovery. Many nanoparticle medicines are now being researched for drug delivery. The most extensive application of nanotechnology is in pharmaceuticals.

**Keywords** –Nanotechnology,Drug delivery,Herbal remedy,Microparticles,Health impact,Application

## INTRODUCTION:

The Greek word "nanos"("dwarf") is where the phrase "nanotechnology" originated. 1000.000.000 m, or $10^{-9}$ m, is the size of the nano device and nano approach. Nanotechnology refers to the incredibly small particles, ranging from 1 to 100 nanometers, that are made up of atoms, molecules, and fragments of molecules. It also describes the unique interactions between molecular level matter and manmade materials[1].The most comprehensive and ongoing method for consistently enhancing performance is the drug delivery system at the nanoscale designed for herba extract release. Compute the NDDSs for the chemicals included in plant extracts to do this.(Source: ) Drugs containing nanoscale herbal remedies hold great potential for the decorative movement and can help overcome many challenges related to plant medicine. The most advantageous portion of the supplying herbal treatments using nanocarriers will be[2].The Studies on nanoparticles and anticancer plant extracts are currently being conducted [3].As a result, incorporating natural remedies into the advancement of practical medicine represents a distinct strategy aimed at treating multiple concurrent disorders. [4]. Due to their characteristically small size, nanoparticles can be recycled for targeting to the diseased problematic areas without the need for the inclusion of a specific ligand, which is a new emerging skill in the drug innovation field. Due to their alleged origin and few side effects, herbal medications are gaining popularity in both developing and developed nations. Nanotechnologies, which are rapidly developing, have given emerging novel herbal medications considerable support. Foods and food ingredients known as nutraceuticals offer health benefits above and above those of basic nutrition, yet many of them have lower bioavailability. The 21st century's most sophisticated scientific method is nanotechnology. Analyzing how nanotechnology and biological medicine are related can lead to the presentation of nanotechnological techniques for the bioavailability development of herbal medicines. Nanotechnology is one of the most rapidly evolving, potent, and advanced and innovative skills in the present period have a profound and positive impact on the progress of biomedicine and the improvement of the effectiveness of herbal medicines by enhancing their bioavailability.The proliferation of nanoherbal medications with high bioavailability will result from the application of nanotechnology to their nanomization, initiating in a new generation in the discovery of herbal drugs[5]. Increasing the usage of nanotechnology could meet the need for food.The size of fertilizer particles is reduced and uniformized by chemical interactions between nanoparticles and fertilizers[6].This technique gives nanofertilizers durability and a large specific surface area, greatly enhancing their efficacy [7].

## NOVEL DRUG RELEASE METHOD

An innovative drug delivery of some aspects
1. There is an expectation that several fundamental reasons will help overcome the limitations of the traditional approach to herbal medicine.
2. In addition to lowering the recurrent quantity, nanoparticles have the ability to recover differences, solubility, drug release care, and efficiency.[9]
3.The nanoparticles' variable dimensions increase the entire surface area of the medications, producing results that are foretelling in blood.[9]
4." Minimizing toxicity helps maintain the healing properties."[9] Enhances nanoparticle diffusion and preservation.[9].
When compared to conventional preparations of plant constituents, nanoformulation has a number of advantages, including improved permeability, solubility, bioavailability, therapeutic action, stability, and enhanced allocation within tissues. Nanotechnology is one of the input novel drug delivery methods under examination. With Compared to traditional preparations of plant ingredients, nanoformulations are thought to provide a wide range of advantages, such as increased permeability, solubility, bioavailability, therapeutic activity, and stability.[10][11].

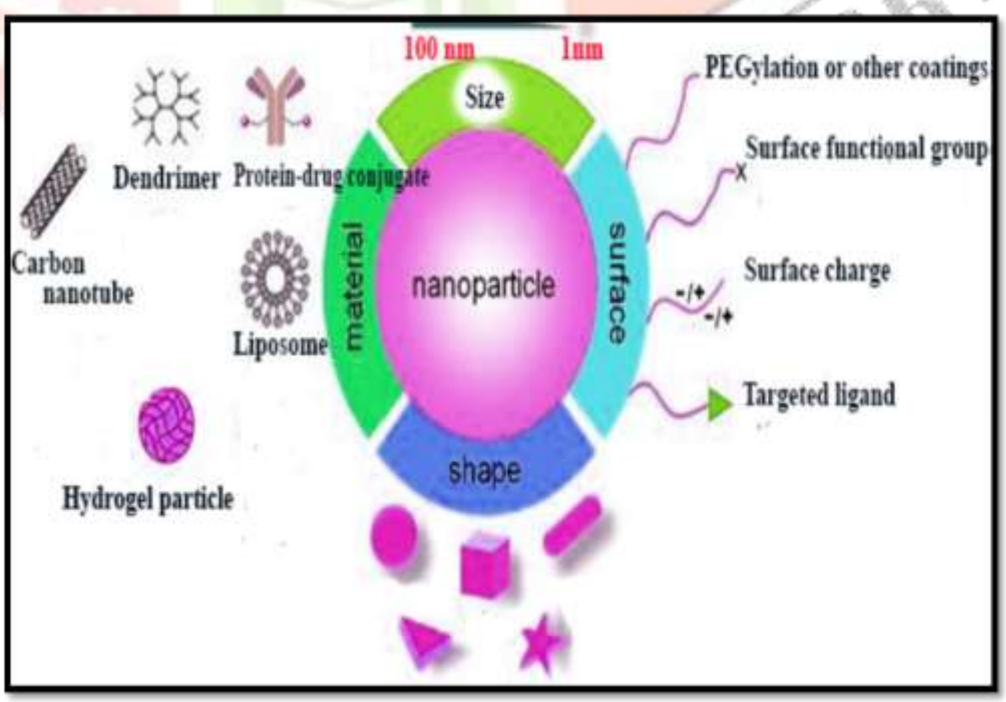


**Fig.1General representation about nanoparticle**

## METHODS OF NANOTCHNOLOGY FOR HERBAL MEDICINE

**1.High-pressure homogenization method-**

In the high-pressure homogenization method, the triglyceride is pressed through high pressure from one side to another with a very high cut-off anxiety, resulting in a disorder of particles down to the variety of nanometers. This technique remains extremely dependable on the effective method to scale up operations and to nanostructure lipped transporters[12].

**ADVANTAGES-**

1.Low risk of product contamination.
2.It is allows aseptic production of nanosuspension for parentral administration. 3.particle size may reduce upto 1nm.

**a)Hot Homogenization method-**

Hot Homogenization In particular, high temperature causes hot homogenization, which reduces particle size due to reduced inner phase viscosity, which is often ideal for medications with temperature sensitivity to a certain level when the material is exposed to an elevated temperature for such a limited, the rate of drug and carrier degradation increases as the temperature rises. crystallization can be significantly slowed, and the sample can exist in a supercooled melt state for a few months. Since the drug is partitioned into the aqueous process during homogenization and many of the drug particles stay at the outermost surface of the SLNs when cooled, HHT is a poor technique for hydrophilic drug candidates, resulting in burst release [13]. The drug-containing melt is dispersed in a heated aqueous surfactant solution of the same temperature using the hot homogenization method. After homogenizing the collected preemulsion with a piston-gap homogenizer (e.g., Micron LAB40), cooling the hot O/W nanoemulsion to room temperature is performed, and the lipid recrystallizes, resulting in stable lipid nanoparticles [14].

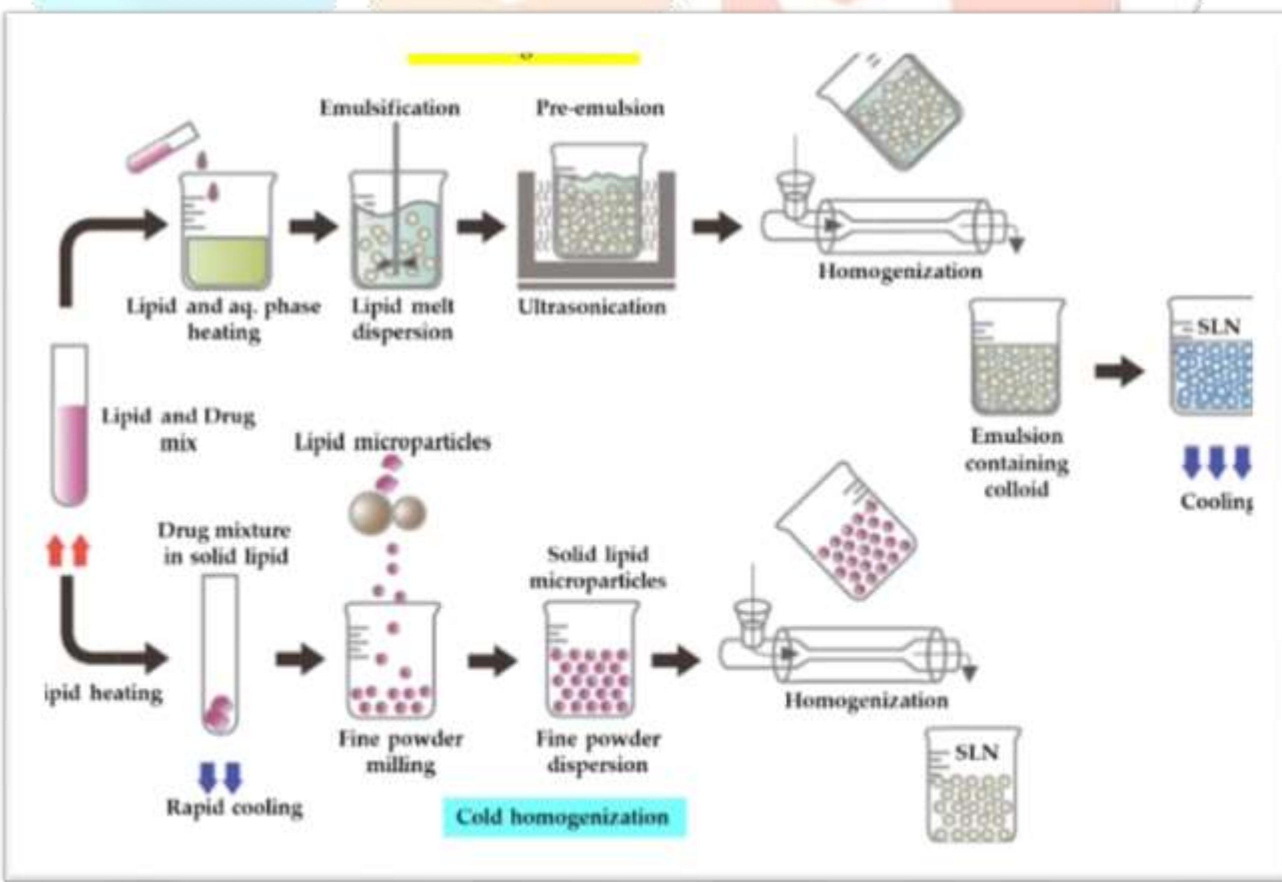


**Fig.2 Homogenization method**

Higher temperatures cause the inner phase viscosity to decrease, resulting in smaller particle sizes. High temperatures, on the other hand, accelerate the degradation of the drug and the carrier. The homogenization process can be replicated as required. It's important to remember that high-pressure homogenization raises the sample's temperature (approximately 10°C for 500 bar). 3–5 homogenization cycles at 500– 1500 bar are usually acceptable. Due to particle coalescence, which occurs as a result of the particles' high kinetic energy, raising the homogenization pressure or the number of cycles often leads to an increase in particle size**.**

**b)Cold homogenization-**

In this approach, the drug is melted in the lipid melt, and after that, it is quickly cooled using liquid nitrogen or ice crystal. Milling leads to the production of nanoparticles in the range of 50-100 nm, which can be dispersed in a cold surfactant that produces a pre-suspension. High-pressure homogenization (PHP) is used to split the nanoparticles into SLNs at the ambient temperature. All the main drawbacks of the hot homogenization approach are resolved by the cold homogenization procedure[15].

**2)Solvent emulsification-diffusion method-**

In this technique, a water-immiscible organic solvent is employed to dissolve the solid lipid. The emulsion is formed by dispersing the lipid phase in an aqueous phase containing a surfactant. The organic solvent is allowed to evaporate from the emulsion at reduced pressure. As a result of organic solvent evaporation, the SLNs are prepared in the aqueous phase (by applying the lipid precipitation process in the aqueous phase). This process does not undergo thermal stress; however, the use of an organic solvent is considered as a disadvantage. The size of the particle differs according to the solid lipid and surfactant. Patravale and Mirani prepared SLNs-based gel for topical use using the solvent emulsification-diffusion method[16].

**3)Solvent evaporation method-**

Cyclohexane, which is a water-immiscible organic solvent, is used to dissolve the solid lipid, and then it is emulsified with the aqueous phase. When the solvent is evaporated, nanoparticles dispersal is obtained by the deposition of the lipid in the aqueous phase by providing the nanoparticles of 25 nm mean size. By using high-pressure homogenization, the lipid solution is emulsified in the aqueous phase. Under the reduced pressure of 40–60 m bar, cyclohexane was removed from the emulsion by evaporation. Amasya et al. prepared 5-fluorouracil-loaded SLNs using the solvent evaporation method [17].

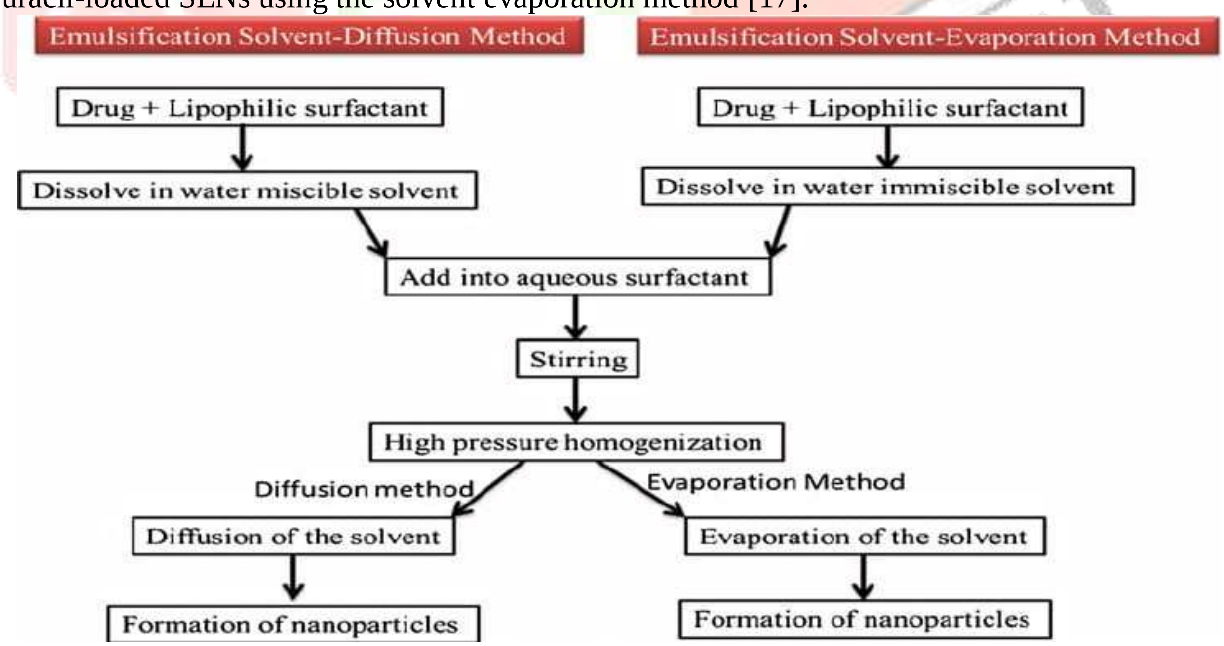


**Fig.3 Solvent evaporation method**

**4)Nanoprecipitation-**

Also known as antisolvent precipitation, desolvation, solvent displacement, and solvent shifting. Developing nanoparticles is explained by nucleation theory, which involves several steps: particle nucleation, growth, and aggregation.Nucleation occurs when the concentration of polymer reaches the critical limit of saturation, i.e., when the breaking of the interface between the polymer and solvent is carried out through the addition of the aqueous phase. Growth occurs with a release of energy, the particles being added to the core by growth through condensation or coagulation. During the aggregation, a release of energy is also present. In this step, it is important to maintain control by some type of stir, which will help homogenize the nanoparticles and achieve uniformity. The temperature also directly affects the rate aggregation[18]. It creates an organic phase and an aqueous phase. The organic phase contains a solvent that must be miscible or partially miscible in the aqueous phase; the polymer (synthetic or natural), which will be used to create the polymer matrix of the nanoparticles, must be soluble in the solvent and therefore insoluble in the aqueous phase. The active ingredient used must be soluble in the solvent, and it must have some interaction with the polymeric matrix to be formed, and the aqueous phase will be constituted solely of water and a surfactant (stabilizer, tensoactive). During the process, an organic phase is add by dropwise to the aqueous phase under moderate magnetic stirring.[19] Another option is to quickly add the aqueous phase to the organic phase, inducing an instant precipitation, mainly in nanoscale.[20]The basis of this technique involves an organic phase (solvent mix) being added into the aqueous phase. The solvent phase tends to have an effect of diffusion, while the polymer automatically tends to collapse forming nanoparticles or microparticles that can encapsulate an active ingredient that is contained in the organic phase [21]

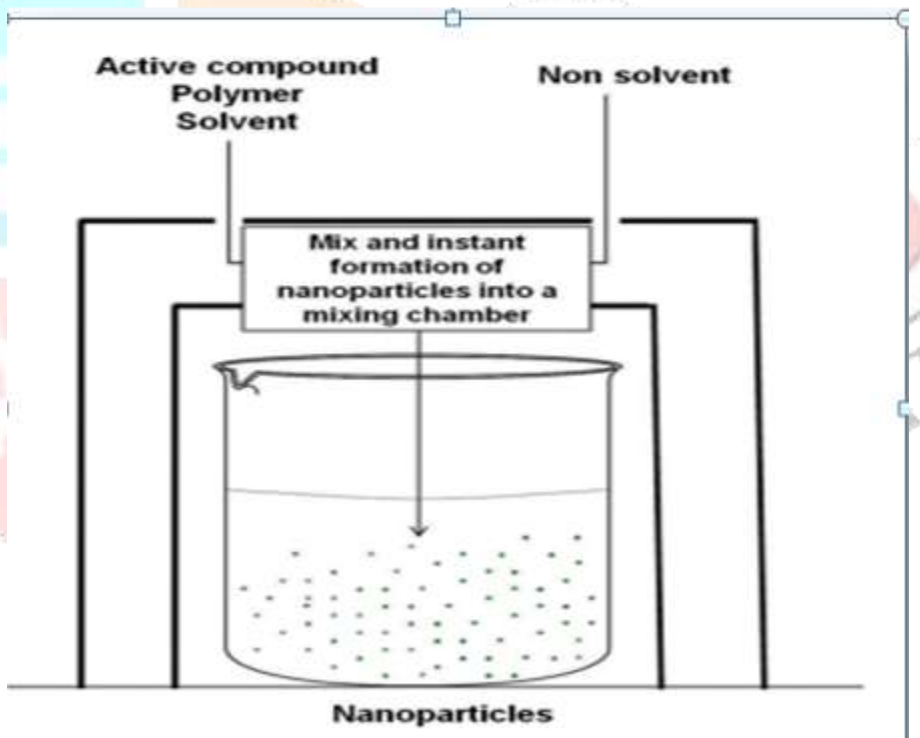


**Fig.4 nanoprecipitation method**

**5) Supercritical Fluid Extraction-**

This is one of the most promising methods for producing solid nanoparticles, which works on the basic principle that lipid nanoparticles are formed from o/w emulsions by supercritical fluid extraction (SCF) [22]. The main advantage of this approach over other techniques is that it uses low temperatures (35 ◦C) and does not use organic solvents to make nanoparticles, i.e., solventless processing [23]Carbon dioxide ($CO_2$) is often used.

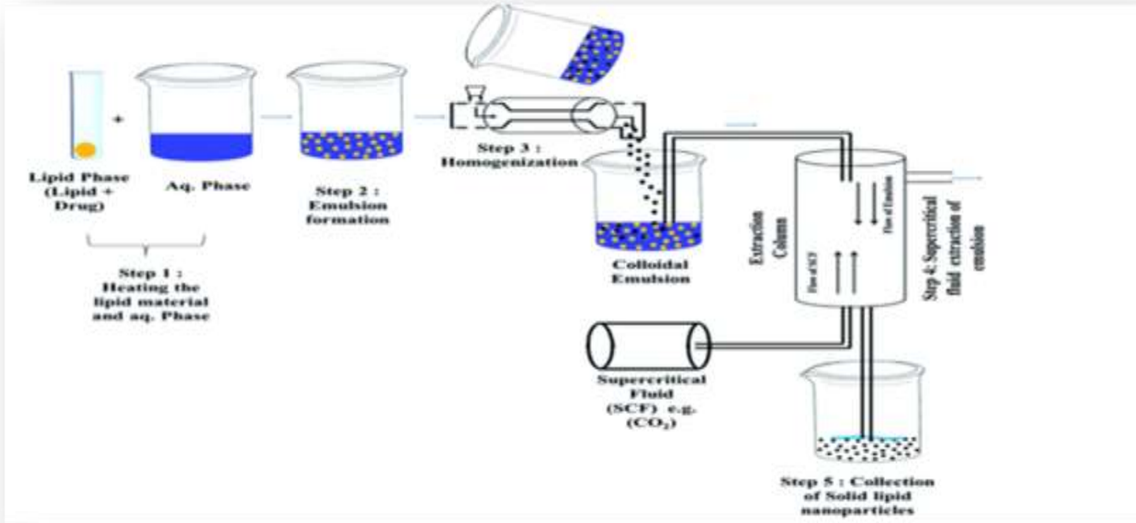


**Fig.5 Supercritical fluid extraction of emulsions (SFEE)**

It is process of generating lipid nanoparticles using emulsions with Supercritical Fluid (SCF) technology. In this method, the lipid component and the drug are dissolved in an organic solvent containing an appropriate surfactant, such as chloroform, to create the organic phase. Additionally, a high-pressure homogenizer is employed, along with a cosurfactant, to generate an oil-in-water (o/w) emulsion. The supercritical fluid, maintained at a constant temperature and pressure, is introduced in a counterflow manner, while the o/w emulsion is supplied from one end of the extraction unit, typically the top, at a fixed flow rate. Continuous solvent extraction from o/w emulsions is employed to produce dispersions of lipid nanoparticles [24].

**1.Benefits of nanotechnology for cancer-**

These substances are prepared to operate seamlessly and conveniently, carefully addressing and acting as therapeutic agents. They are specifically designed to target and treat the symptoms of neoplasms effectively, focusing on particular cancerous microorganisms. Importantly, they can overcome physiological barriers in the body, such as dense stromal membranes in the pancreas, the blood-brain barrier, and the central nervous system [25].

Agents from nanotechnology utilized in the treatment of malignancies, like liposomes, are constructed with lipid materials serving as nanocarriers for melanoma medications. Nanocantilevers, configured as array-like structures, aid in identifying the terminal proteins present in specific tumor types [26]. Quantum dots, fluorescent nanocrystals, are widely used

in cancer treatment. Superior cancer treatment based on nanotechnology includes [27].

- Nanotechnology-related gene medication procedure
- Nanotechnology originated photodynamic treatment
- Nanotechnology-based radiotherapy and radiofrequency treatment
- Nanotechnology-based carcinoma theranostics.

**2.Osteoporosis-**

Osteoporosis, a bone condition associated with aging, entails a progressive reduction in bone mass and density, resulting in bones becoming fragile and susceptible to fractures. The spine, wrist, and hips are commonly affected sites, and other regions like the arm or pelvis may also be influenced [28]. In women post-menopause, the consumption of vitamin D and K supplements has been acknowledged as beneficial for reducing the likely fractures[30][31].Raloxifene, Denosumab, Bisphosphonates, and Teriparatide (a recombinant parathyroid hormone) have been shown to be effective in the treatment of women with postmenopausal osteoporosis[32].The present formulation is availed as a microemulsion, nanoparticle, nanoemulsion, and a micro particle with a dose of 0.1-5000 mg weekly or bi-weekly or daily[33].The present composition is meant for oral, topical, injectable, via toothpaste, and in combination, in cases of osteoporosis and bone fracture in animals.

**3.Hyperlipidemia-**

A 30% reduction in blood cholesterol levels in non-diabetic patients is achieved through a method involving the oral administration of fenugreek seed extract in various forms such as nanoparticles, microparticles, pills, capsules, granules, or liposomes for a consecutive period of 30 days. The preparation of the fenugreek seed extract composition for formulation into nanoparticles involves grinding about one-third cup of dry fenugreek seeds into a powder. Subsequently, the powder is mixed with 15 cups of water and boiled for 10 minutes. After cooling the mixture to room temperature, a cooled extract is obtained. This extract is then strained and refrigerated before being orally administered [34].

**4.Nanoformulation in diabetes treatment-**

Nanotechnology-based approaches offer improved therapeutic management of diabetes mellitus with a minimized risk of acute and chronic complications [35] the advancement and effectiveness of nanobased formulations of antidiabetic agents from plant sources.

**a)Curcumin-**

self-nanophospholipid dispersions were reported to enhance oral bioavailability of curcumin over conventional formulations in rats [36] Curcumin nanoparticles prepared by a modified emulsion-diffusion-evaporation method was found to reduce fasting blood glucose and glycosylated hemoglobin levels significantly via increasing the expression of insulin and insulin receptor (IR) mRNAs in diabetic rats [37]. Curcumin-ZnO (10 mg/kg, for 21 days) nanoparticles were claimed to be more effective than curcumin nanoparticles (50 mg/kg, for 21 days) in diabetes therapy in terms of reduction of blood glucose, improvement in serum insulin, and activation of GLUT2 and glucokinase genes [38].

**b)Myricetin-**

Myricetin nanoparticles were discovered to be more potent than metformin, even when administered in significantly smaller amounts [39]. The same research group also noted that solid lipid nanoparticles loaded with myricetin could reduce oxidative stress, inflammation, fibrosis, and apoptosis in mouse proximal tubules exposed to high glucose in vitro. Consequently, the formulation is anticipated to be equally effective in addressing diabetic nephropathy and other complications associated with diabetes.

**c)Catachin-**

Inulin modified with catechin and chitosan nanoparticles modified with catechin were found to have enhanced effectiveness in combating diabetes compared to free catechins and acarbose. This improvement was observed through their increased inhibitory effects on α-glucosidase and α-amylase [40,41]. Moreover, the antioxidant potential of catechin-modified chitosan nanoparticles surpassed that of the original catechins. Researchers developed solid lipid nanoparticles and nanostructured lipid carriers to improve solubility, stability, and the ability to release substances gradually. Additionally, a thymoquinone nanoformulation exhibited a sustained release profile, thereby enhancing its therapeutic effects for antidiabetic purposes [42].

**5)Nanotechnology in agriculture-**

**a)Nanofertilizer:**

The effectiveness of fertilization is closely linked to the size distribution of nanoparticles (NPs). Remarkably, nanotype fertilizers consistently feature smaller particle sizes and a higher particle count per unit, resulting in augmented specific surface areas. This characteristic is noteworthy for its potential to enhance fertilization efficiency.[43]Top of FormEnhanced engagement with leaves and roots boosts the uptake of fertilizers by plants. Moreover, the distinctive attributes of nanoparticles (NPs) yield enduring effects. Fertilizers encapsulated in NPs withstand degradation processes like hydrolysis, photolysis, evaporation, microbial decomposition, and weathering [44]. Additionally, the porous structures and compact size profiles of NPs may aid their entry into cells through molecular transporters or ion channels, triggering signaling pathways associated with phytohormones or other growth factors [45].

**b)Nanopesticides**:

The utilization of nanomaterials for formulating or encapsulating insecticides, herbicides, fungicides, and bactericides holds great promise for reducing the dosage of chemical pesticides, enhancing crop production, and fostering sustainable development [46]. Nanoinsecticide particles exhibit a smaller and more centralized structure, imparting stability and a slow-release capability. These characteristics not only amplify the efficacy of insecticides but also reduce their toxicity to humans. Moreover, the heightened biological toxicity of concentrated nanoparticles offers a distinctive pathway for directly impeding the growth of pests, bacteria, and viruses [47]

**c)Nanoherbicides:**

Solid lipids stand out as the most fitting nanocarriers for nanoherbicides among various types of nanoparticles. This preference is attributed to their commendable chemical stability and straightforward metabolism [48]. As an illustration, applying metsulfuron methyl-loaded polysaccharide nanoparticles to weeds growing in wheat through foliar application led to a significant reduction in weed biomass compared to conventional herbicide methods[49].

**6)Nanosensor:**

Nanosensors are employed for monitoring the well-being of living plants in various agricultural applications. These include managing nutrient levels, tracking growth, assessing pest and disease presence, detecting soil conditions, overseeing food production, and identifying plant hormones [50][51].Top of FormNanosensors play a crucial role in overseeing the health of living plants across diverse agricultural applications. These applications encompass the regulation of nutrient levels, monitoring growth, evaluating the presence of pests and diseases, detecting soil conditions, supervising food production, and identifying plant hormones [50][51].

**7)Nutraceutical:**

In the pharmaceutical field, nanoparticle formulations consist of nutraceuticals or pharmaceutical compounds such as curcumin, quercetin, resveratrol, genistein, diallyl sulfide, S-allyl cysteine, allicin, lycopene, capsaicin, diosgenin, 6-gingerol, ellagic acid, ursolic acid, silibinin, anethol, catechins, eugenol, indole-3-carbinol, limonene, beta-carotene, dietary fibers, and emulsifiers. These formulations, with a size below 100 nm, are utilized for the treatment.prevention of inflammation.Top of Formand conditions associated with inflammation, efforts have been made to enhance the bioavailability of curcumin. Adjuvants, such as piperine, were incorporated to disrupt glucuronidation, thereby boosting water solubility and excretion. Co-administering 20 mg of piperine has the potential to elevate the plasma concentration of curcumin [52].

**a)Nano Probiotics:**

Micro and nano probiotics, living microorganisms intended to enhance health through ingestion or topical administration, are exemplified by foods such as yogurt, kefir, sauerkraut, tempeh, kimchi, and others. In recent years, probiotic research has gained popularity. Because of their beneficial impact on both the economy and the well-being of farm animals, probiotics are considered a practical substitute for antibiotics. The International Scientific Association for Probiotics and Prebiotics (ISAPP) has introduced a diverse array of products containing probiotics, all designed to have positive effects on health. These include medications, infant formulas (like initial milk), medicinal supplements, and foods (such as fermented dairy products with purported health benefits) [53].

**b)Nano Formulation of Bioactive Compounds:**

Flavonoids, phenolics, proteins, and various bioactive compounds are vital for fostering robust cellular growth and differentiation refer to how cells in living things increase in size and specialize to perform specific functions. It's like cells getting bigger and taking on specific roles to do different functions in the body.Moreover, they play a pivotal role in disease prevention by contributing to the proper functioning of biological system.Recent research has improved the recovery of breast cancer by combining bioactive substances with already available medications like cyclophosphamide and paclitaxel.As a result, treating various diseases opens up new opportunities when drugs are combined with bioactive substances. Hence, the creation of biological active molecules and medications also balances off the drawbacks of drug molecule excess.On the other hand, in some instances; the appropriate quantity of bioactive substances is not consumed. Therefore, uncontrolled intake also contributes to a decline in health. Nowadays, there are special foods and supplements designed to tackle these issues. Other industries that have also taken advantage of this biological importance include optoelectronics and healthcare, using light modification and functionalization.They provided a strong market for bioactive substances. So, a major requirement or issue in scientific research is creating tiny, well-designed versions of bioactive compounds using better tools or methods for making and delivering them.[54].

**8)Herbonanotechnology for Targeting Asthma:**

Specifically targeting the lungs with medication administration appears to be a promise of therapeutic strategy. To put it simply, this happens because of the special design of the lungs. The lungs have thin barriers, a large surface area in the alveolar region, a lot of blood vessels, and low proteolytic activity. Methods for giving medicines that focus on the lungs have been shown to be helpful for lung issues like asthma, and they might make treatments more effective. Pulmonary delivery is simple because the medication can be given intravenously or intratracheally. Nanotechnology now has a strong foundation for better disease detection and treatment because to recent developments in science and technology.[55,56].

**9)Herbal nanoformulation:**

Because they are not harmful, easily absorbed by the body, and release effectively, nanogels have shown advancement in herbal formulations for oral use. Curcumin, a widely studied natural ingredient, has been extensively researched in the context of cancer. The inverse miniemulsion approach is used to create alginate aldehyde gelatin nanogels, which have greater curcumin entrapment. When curcumin is present in acetone, it helps enhance the encapsulation of nanogels within the cross-linked polymer network. The OH terminal group of curcumin and the unreacted OH functions in Alginate aldehyde interact, creating better encapsulation through end-to-end hydrogen bonding. Curcumin becomes more soluble when enclosed in nanogels, improving the effectiveness of drug loading and increasing the therapeutic impact for oral administration [57].

**a)Radix salvia miltiorrhiza**:

• Preparations: nanoparticles of R. salvia miltiorrhiza
• R. salvia miltiorrhiza is one of the active components
Applications for formulations with nanostructures Enhance bioavailability
• Biological activity: myocardial infarction, angina pectoris, and congective heart failure.
The spray-drying technology is used in the preparation process, and IV is the route of administration[58].

**b)Artemisinin nanocapsule:**

• Formulations: nanocapsules containing artemisinin
Sustained medication release is a use for nanostructured formulations' active component, artemisinin.
• Anticancer biological activity
Self-assembly technique is the preparation method,
while IV is the route of administration[59].

**c)Berberine-loaded nanoparticles**:

• Preparation: nanoparticles containing berberine
• Berberine is the active component
Nanostructured formulations find applications in various areas, such as maintaining a steady release of drugs, demonstrating biological activity against cancer, and employing the ionic gelation technique in production, IV administration.[60]

**d)Taxel-loaded nanoparticles:**

• Preparation: nanoparticles loaded with taxol
Taxel is the active component. Nanostructured formulations are used to increase bioavailability and sustained
• Emulsion solvent evaporation method is the preparation method; biological activity: anticancer; and route of administration: IV[61].

**10. NANOTECHNOLOGY IN AYURVEDA:**

Bhasma are more similar to nano crystallite materials, which are solids made up, at least in one dimension, of crystallites with diameters smaller than 100 nm. By using scanning electron microscopy to analyze surface morphology, the nanoparticle size of Lauha Bhasma was validated. We noticed spherical nanoparticles with a 17 nm diameter[62]. A TEM and atomic force microscope investigation of Swarna Bhasma has shown that its main component is globular gold nanoparticles measuring 5657 nm in size. For example, Pittala (Brass) Bhasma- Pittala, a zinc and copper alloy, is another essential Misra Loha that has been used since the Samhita Kala era. A number of Pittala Bhasma formulations are helpful for conditions like Pandu (Anemia), Kusta (Skin Disorder),etc[63]. Bronze-colored Kamsya Bhasma: Kamsya is a copper and tin alloy Only Kamsya in the Pushpa form, which produces a clear sound, feels smooth to the touch, is soft, has a somewhat grayish color, turns red when heated, and is free of impurities, is considered suitable for medicinal purposes. For conditions like skin disorders (Kusta), worms (Krimi), etc., doses of 60–120 mg of Kamsya Bhasma have proven to be beneficial [64].

**Evalution of nanoparticles**

**1.Particle size, polydispersity index**

A dynamic light scattering method at a predetermined angle and ideal temperature can be used to determine the particle size and polydispersity index of materials. Using this technique, the formulation's surface charge and physical stability can be revealed.

**2.TEM**

TEM makes it simple to examine the formulation, structural surface, and shape of carriers [65]. The samples must first be diluted with distilled water before being dropped onto a copper grid covered in a 200 mesh carbon sheet and then stained with the appropriate staining solution. Analyze the shape after drying the sample..

**3.Scattering of dynamic light**

This method is the fastest way to measure particle size, and it is commonly employed to assess the size of colloidal particles in the nano- and submicron range. Dynamic light scattering can be utilized to estimate the distribution of particle sizes.

**4.NMR**

NMR is employed to gauge the size and qualitative attributes of nanoparticles. NMR can be used to ascertain the physicochemical state of the components within the nanoparticles.

**5. Powder X-ray diffraction (XRD)**

A quick, methodological, organized method that can provide data on atomic spacing and unit cell measurement is used to determine the phase of crystalline materials [66]. An intentionally collimated cathode ray tube is used to create the X-ray, which is then directed toward the sample [67].

**6. Differential thermal analyzer/thermogravimetric analysis**

Thermogravimetric analysis (TGA) is a method for studying how the weight of a substance changes with temperature and time under controlled conditions [68]. This technique is applicable to any solid material, whether it is organic or inorganic.Differential thermal analysis is a calorimetric technique that measures temperature and heat surges associated with a substance's thermal transitions[69].

**7. Zeta potential**

If a nanoparticle possesses a charged surface, the existence of ions with opposite charges near the nanoparticle surface generates a screening effect. These layers of dipolar ions move both individually and together with the nanoparticle. The zeta potential's magnitude provides step-by-step information about the particle's stability. Enhanced stability corresponds to a greater electrostatic repulsion, and consequently, a larger potential magnitude [70].

**8. Drug Entrapment Efficiency**

Drug Entrapment efficiency (%) = Amount of released from the lysed nanoparticle X 100 Amount of drug Initially taken to prepare the Nanoparticles[71].

**9.Determination of pH**

The pH of the nanogel was measured using a digital pH meter. The complete glass electrode was immersed into the gel system [72].

**10. Test for Spreadability**

On a glass plate having 1 cm diameter, 0.5 gm of gel was stored. A another glass plate was then positioned on top of it, and 500 g of weight was left there for five minutes. The spreadability was determined[73].

**Advantages:**

1) Nanotechnology has the potential to bring about a significant transformation in various electronic processes, applications, and products. Ongoing advancements in nanotechnology could revolutionize electronic components like nano transistors, nano diodes, OLEDs, plasma displays, quantum computers, and more.
2) Nanotechnology can benefit the energy industry by making devices that produce, consume, and store energy more efficiently in smaller and more effective forms. This technology allows for the creation of smaller and more efficient batteries, fuel cells, and solar cells.
3) It can easily pass through the sinusoidal gaps in the bone because it is smaller than liposomes and micro spheres. compared to other organ systems with long periods of circulation, the marrow and spleen

4) The resistance of a medication or protein to enzymatic degradation is increased by nanoparticles • They offer a significant improvement over present practices.The effectiveness and efficiency of oral and intravenous (IV) delivery routes[74].

5) Increased the selectivity and safety of natural drugs.

6) Improved solubility results in increased effectiveness and less frequent doses.

Biodegradable and safe for use.

8) They are useful for transporting medication to liver cells that are active in phagocytosis.

9) Herbal nanoparticles are distributed evenly throughout the body.

10) Low danger of side effects and controlled, predictable drug release rate.

11) Because these particles are so tiny, breathing them in can actually cause problems, similar to the ones that individual experiences after breathing in asbestos' tiny particles.

Currently, nanotechnology is quite costly both in terms of production and creation. The complexity involved in making nanotechnology contributes to the higher costs associated with products utilizing this technology.

**Disadvantage:**

1)Profound immunogenicity.

2) Expensive and time-consuming.

3) Possibility of poor targeting[74].

4) Since these particles are extremely small, inhaling them can cause problems, similar to how inhaling tiny asbestos particles can lead to issues.

5) Nanotechnology is currently pricey, and the process of developing it can be very costly. It's also quite intricate, which contributes to the higher costs of products made using this technology.

6) Requires a highly competent individual to formulate and reduces the capacity to modify the dose.

7) Ineffective drug loading and trapping efficiency.

8) Production-related molecular challenges cannot be undone.

9) The occasionally produce an allergic reaction.

10) There is instability and toxicity.

**Challenges-**

1. The quickly advancing field of nanotechnology has caught the attention of the public and led to extensive discussions about its safety and potential health risks. The use of nanomaterials introduces new challenges, especially in predicting, understanding, and addressing potential health issues. Research indicates that low-solubility nanoparticles can be more toxic and harmful on a weight basis compared to larger particles [75].

2.Nanoparticles can raise concerns about explosions and catalytic reactions. It's important to note that only specific types of nanomaterials, especially those with high reactivity and mobility, are considered risky. The mere presence of nanomaterials in a laboratory setting doesn't inherently pose a threat to humanity unless further studies reveal their harmful effects.

3. In order to solve stability-related problems like coalescence and creaming, processing different nanoformulations like niosomes, liposomes, and polymeric nanoparticles need considerable energy.Typically, one of two processes—top to bottom (pulverization, micronization) or bottom to top (nucleation)—is used to create nanoformulations. Controlling the particle's growth is the main problem while scaling up the formulation. Variation between batches is the effect of this.

4.Solubility improvement for hydrophobic or poorly soluble in water drugs.improved biomembrane permeability.

5.targeting a specific organ or tissue with a medicine and delivering the active ingredient over a biological barrier.

**Future prospective-**

Exploring natural nanoparticles for creating medicines to treat tumors could yield significant research results. Integrating "herbal medicine" into nanocarriers has the potential to enhance its effectiveness in treating various illnesses and promoting overall well-being. Ongoing studies are investigating successful cases with promising results. Herbal medicines contain beneficial compounds such as antioxidants, which can be used in specific nutritional applications[76]. In the past, the collaboration between traditional "herbal medicines" and modern drug delivery methods has been acknowledged. Historically, health advancements were assessed for their effectiveness and enhancement of patient quality of life. Nowadays, in addition to efficacy, healthcare costs must also be taken into account. Nanotherapeutic products, although more intricate and costly than conventional alternatives, are designed to bring an overall reduction in healthcare costs. The anticipated decrease in healthcare costs is expected to result from increased nanotherapeutic efficacy, shorter in-patient stays, reduced individual healthcare expenses, and successful management of expensive primary diseases. The medication market is directly impacted by these developments in nanomedicine.

**Conclusion-**

Given the many health issues, it is vital and to be expected that nanotechnology would be used for disease prevention and health promotion. It has enormous promise for delivering herbal medicines and nutraceuticals.Even though nutraceutical and herbal medication delivery uses of nanotechnology show promise, more creative research is required to address the cost-effectiveness and long-term safety of nanometerials. Understanding the constraints imposed by FDA rules on nanoformulation methodologies and utilizing the currently available capabilities of nanoformulations can help overcome these constraints. Thene lgth of time needed for those now in the early stages of development and waiting for recognition is a significant obstacle that herbal nanoparticles encounter. regarding the use of nanotechnology in herbal products is that it offers promising opportunities for enhancing the effectiveness, bioavailability, and targeted delivery of herbal compounds. Shrinking the particle size of herbal remedies to the nanoscale could augment their therapeutic effects as it facilitates better absorption within the body.To assure the efficacy and safety of nanosized herbal compositions, additional study on their security and long-term impacts is required.

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