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PHARMACEUTICAL NANOSAPSULE NOVEL TECHNIQUE TO TREATMENT OF NOVAL DRUG DELIVERY SYSTEM

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Abstract:

Nano capsules are subjected to a variety of characterization and evaluation procedures. To achieve controlled release and efficient drug targeting, dispersed polymer nanocapsules can be employed as nano-sized drug carriers. Drug-loaded polymeric nanocapsules have been shown to have potential applications in drug delivery systems To develop current nano-particulate drug delivery methods, enormous research efforts have been made. Newly discovered therapeutic compounds with a modest biopharmaceutical profile, on the other g (NC), have the potential to provide therapeutic benefits in the field of drug delivery. The perpose of this review is in future the nanotechnology can creat many wonders in medical field. Nanotechnology is wonderfull technology that can used in diagnosis and treatment in medical field. This review was aimed to knowing the preparation, new aspects, and the applications of the nanocapsules.

Keywords: Nanocapsules, Polymerization, Nanoprecipitation, Coacervation, Self-Healing Materials.

Introduction

Nanocapsule is a Nanoparticle that is spherical, hollow structure with a diameter less than 200nm in which desired substance may be placed. They can be filled with a solvent, either polar or non polar Nanocapsules range in size from 10 nm to 1000 nm and are available in a variety of sizes They have a liquid/solid core in which the medicine is deposited in a cavity surrounding by a polymer membrane consisting of natural or manmade polymers. Nanoparticles are solid, submicron-sized drug carriers that can be eighter[1] biodegradable

or non-biodegradable. Nanospheres have mtrix type of structure. Nanocapsules are vasicular that the drug isconfined to a cavity consisting of an inner liquid core surrounded by a polymeric membrane. the activesubstance are usually dissolved in the inner core but may also be absorbed to the capsule. The protective layer, which is often pyrophoric and rapidly oxidised, has piqued interest because it delays the release of active compounds. Natural chemicals are presently being tested for the treatment of a variety of diseases, including diabetes, cancers, cardiology, inflammation, and microbial disorders, due fto their unique benefits, such as minimal toxicity and side effects, low cost, and high therapeutic potential. As a result of these issues, numerous natural substances are failing to progress through the clinical trial stages.[2] Nanoparticle drug delivery systems are designed technologies that use nanoparticles to deliver therapeutic drugs with precision and control. Nanoparticles feature a high surface-area-to-volume ratio, chemical and geometric tenability and the ability to change shape to interact with biomolecules to facilitate uptake across the cell membrane.[3]

For targeting and controlled release, the surface area also has a high affinity for drugs and small molecules such as ligands or antibodies.Nanoparticles are a class of organic and inorganic materials.[4] Each material has uniquely tunable properties, allowing it to be designed for specific applications such as

1. Crossing the blood brain barrier (BBB) in brain brain disorders.

2. Improving targeted intracellular delivery to confirm that treatments reach the appropriate structures within the cell.

3. Integrating diagnosis and treatment

Nanocapsules for Drug Delivery Scientists in Australia have developed minute Nanocapsules which can be used to target anti-cancer drugs to tumors, sparing other healthy tissue from side effects. The capsules, which measure about 1 micron across - or 1 thousandth of a millimeter - can be coated with an antibody which directs them from the bloodstream to a tumor. Once they are in the tumor, a quick blast with a harmless skin-penetrating laser producing near-infrared light causes the capsules to open up, discharging their contents. To make them, a polymer which when added to a suspension of drug particles forms a sphere enclosing the drug, several layers thick Future Nanocapsule Bandages to fight infection[4] Conventional dressings have to be removed if the skin becomes infected, which slows healing and can be distressing for the child. This advanced dressing will speed up treatment because it is automatically triggered to release antibiotics only when the wound becomes infected, meaning that the dressing will not need to be removed, thereby increasing the chances of the wound healing without scarring.[5] The color change acts as an early warning system that infection is present, meaning we can treat it much faster, reducing the trauma to the child and cutting the time they have to spend in hospital". This Nanocapsules bandage might also be used for other types of wounds, such as ulcer and even by the military on the battlefield.[6]

Preparing Polymeric Nanocapsules

Shell materials play a critical role in the development of polymeric nanocapsules to load, protect and release bioactive substances.[7] The properties of polymers exert significant influence on the stability, encapsulation e_ciency, release profile and biodistribution of the nanocapsule as drug delivery system. Biocompatible polymeric materials have been extensively considered as appropriate candidates for nanocapsules development.[8] In most cases, these polymers should be biodegradable for the goal of payload-releasing and elimination of nanoparticles.[9] However, non-biodegradable, but biocompatible polymers such as polyethylene glycol (PEG), polyvinyl alcohol (PVA) have also been widely used to contribute to the fabrication of nanoparticles. They can assist drug release via dilusion, thanks to their hydrophilicity. In addition, they could be cleared from blood via the reticuloendothelial system, eventually-despite not being degraded in maller molecules[9,10,11] . To satisfy the different application requirements, various polymers have been employed for the formulation of nanocapsules shell; they can be classified into natural or synthetic polymers according to their source.[12]

Nanocapsules composition Nanocapsules comprise of an oily or an aqueous core, which is surrounded by a thin polymer membrane[13]. Two technologies have been utilized for obtaining such nanocapsules: the interfacial polymerization for monomer and the interfacial nano-deposition method for preformed polymer. The develop-ment in technologies in pharmaceutical research field has been spread widely in designing of the tumor targeting nano-scale vectors, capable of delivering radionuclides. Among them, the lipid nanocapsules (LNCs) as a nanovector-based formulation with bio-mimetic properties[14] shows to be an applicable therapeutic option for HCC (Hepatocellular carcinoma) treatment[15]. It is composed of a liquid lipid core, which is surrounded by a shell of tensioactive. LNCs results in the encapsula-tion of a lipophilic composite of radioactive Rhenium-188

1. In capsule preparation, the positively or negatively surface charged polymer addition comprises the first actual step.

2. Second step utilizes layer by layer self-assembling to form an ultrathin polymer film. Each new layer has the opposite charge to that of previous layer. The polymer coating is thrown by electrostatic gravities. They create shells of well-ordered polyelectrolyte complex layers. This will result in capsule walls with 4 to 20 layers with a thickness of 8-50 nm. The completed capsules will possess precise properties. Additional functions are often taken on by their surfaces for instance to provide connections for antibodies to dock. It is optional that in the case of demand, the core of the capsule can be removed or various substances can fill the empty capsule shells.[16]

Emulsion polymerization Pre-emulsion preparation (Yang et al 2008) for one of the nanocapsules (M-6) is provided as an example. The preemulsion was synthesized by blending two parts; Part I contained 40 g

styrene, 0.8 g DVB (divinylbenzene) , 0.82 g AIBN (2,2′-azobisisobutyronitrile) and 40 g Desmodur BL3175A; and Part II contained 1.71 g SDS (sodium dodecyl sulfate), 1.63 g Igepal CO-887, and 220 g water. Parts I and II were magnetically blended in separate containers for 10 minutes. Part II was then added to Part I under mechanical agitation and the contents were stirred at 1,800 rpm for 30 minutes. The resulting preemulsion was cooled to <5°C before sonication using a Misonix sonicator 3000 (until a particle size <250 nm was achieved). The pre-emulsion was transferred to a three-neck round bottom flask, which was equipped with a mechanical stirrer, reflux condenser, and a nitrogen inlet, and degassed for 30 minutes. The temperature was increased to 70°C and preserved for 8 hours to complete the polymerization.[17] Other preparation methods for nano-capsules include electron irradiation deposition, chemical vapor deposition, laser vaporization-condensation, charge transferring, organic reagent assisted method, solution-liquid-solid method and catalytic vapor-liquid-solid growth. Encapsulation of nanocapsules Recent advances in the encapsulation technology has been utilized to formulate micro/nanocapsules with their explicit application properties.[18]

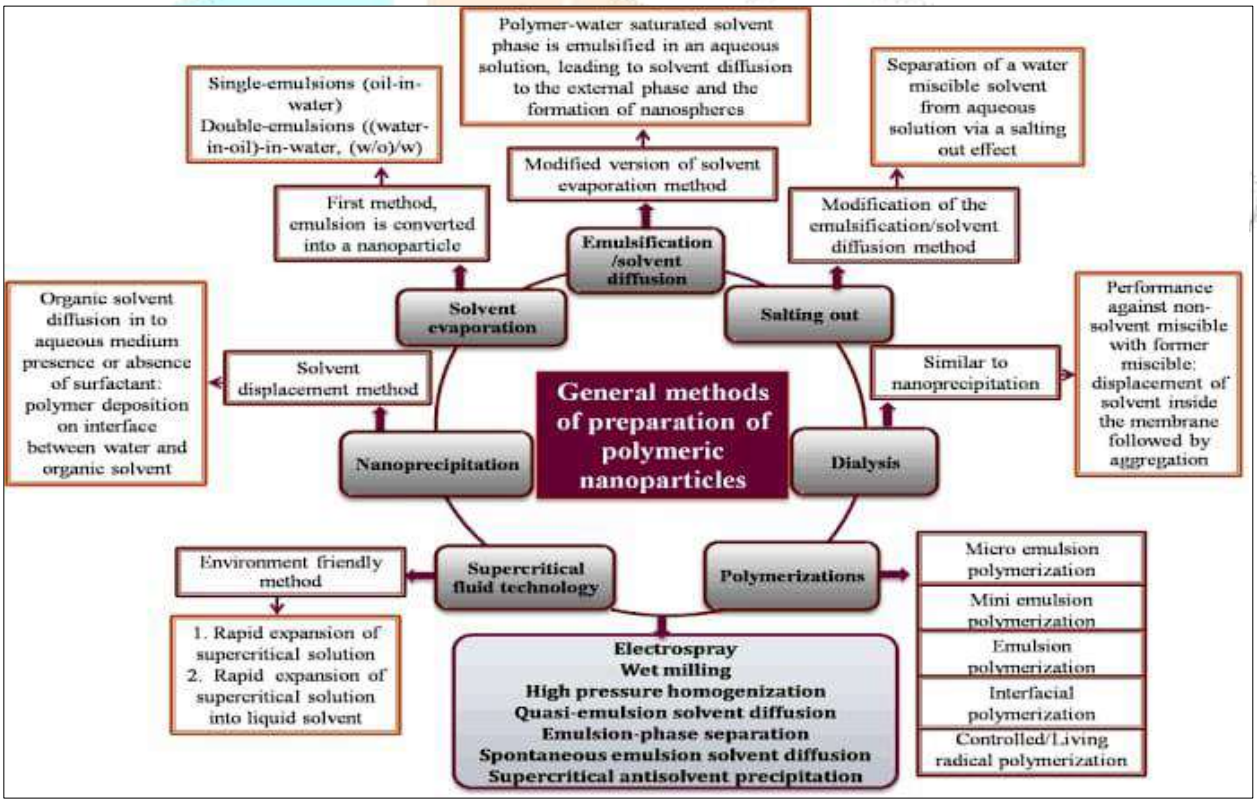

Fig. no. 1 Methodology opf nanocapsule

Methods of Nanocapsule

1. **Emulsion polymerisation method**

Pre-emulsion preparation for one of the nanocapsules is provided as an example. The pre-emulsion was synthesized by blending two parts; Part 1 contained 40g styrene, 0.8 g Divinylbenzene0.82g 2,2'-azobisisobutyronitrile and 40 g Desmodur BL3175A;and part 2 contained 1.71 g SDS (Sodium dodecyl sulfate)[19] , 1.63 g Igepal CO- 887,and 220 g water[9]. Part 1 and 2 were magnetically blended in separate containers for 10 min. Part 2 was added to part 1 under mechanical agitation and the contents were stirred 1,800 rpm for 30 min.[20] The resulting pre-emulsion was cooled to <5°C before sonication using a Misonix Sonicator 3000.The pre-emulsion was transferred to a Three-neck round bottom flask, which was equipped with a mechanical stirrer, reflux condenser, and nitrogen inlet, and degassed for 30 min. The temperature was increased to 70°C and preserved for 8 hours to complete the polymerization.

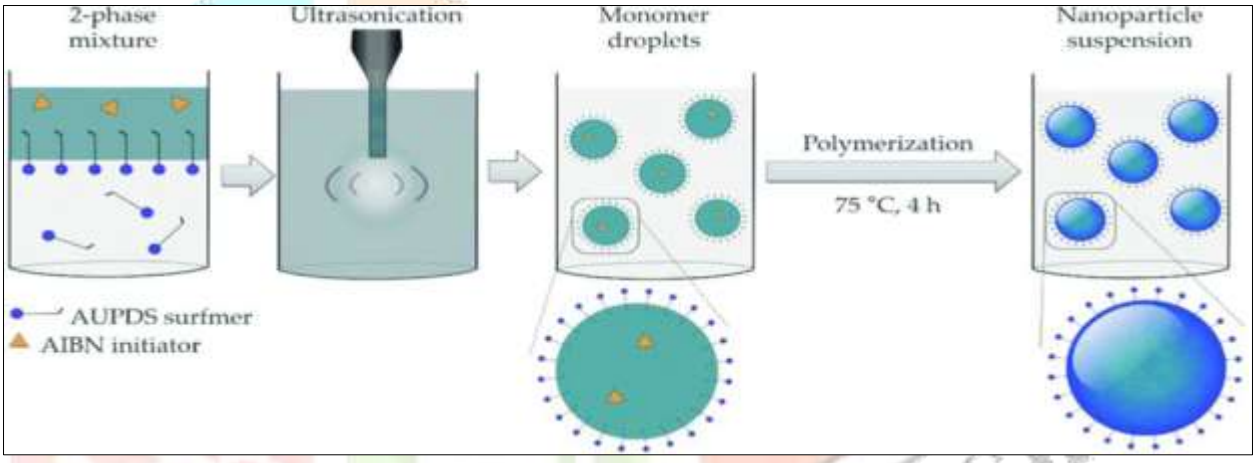

Fig 2. Emulsion polymerisation method

2. **Interfacial polymerisation method**

Interfacial polymerisation is an alternative to bulk polymerisation of condensation polymers, which would require high temperatures. It comprises of two immiscible solvents, in which monomer in one Solvent instantaneously reacting with monomer of the other solver or it may depend on the time scale.Higher molecular weights of monomers are obtained since it is more likely to stumble up on a growing chain than the opposing monomer [21]. The nano capsules can be formulated by using the aqueous core Containing oligonucleotides of isobutylcyanoacrylate in a W/O emulsion. Both organic phase and aqueous phase are used in the synthesis of nanocapsules. Solvent phase containing solvents, polymers, thedrug molecule and oils. On the other hand, the non-solvent phase consisting of a non – solvent or a mixture of non-solvents for the polymers, supplemanted with one or more naturally occurring or Synthetic surfactants. In the solvent displacement method, commonly used biodegradable polymers are Poly-e- caprolctone.[22]

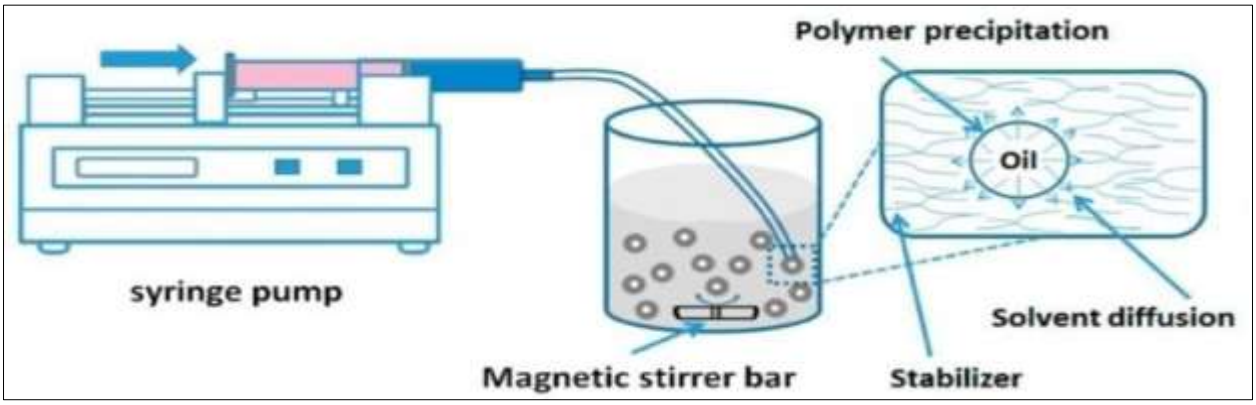

Fig. 3. Interfacial polymerisation method

3. Method of nanoprecipitation

The method of nanoprecipitation is also known as Interfacial deposition or solvent displacement The Biodegradable polymers are extensively utilised. Polyesters, particularly poly-caprolactone, are a type of polymer (PCL),Polylactide (PLA) and polylactide-co-glicolide (PLGA) are two types of polylactide.[23]

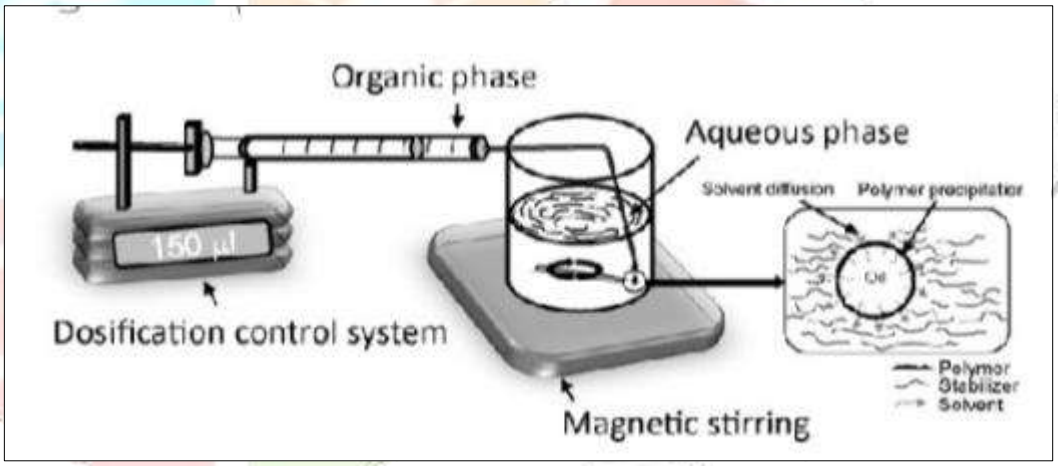

Fig. 4. Nanoprecipitation

4. Emulsion–diffusion:

The water miscible solvent, as well as a little amount of water, are used in this approach.As an oil, an immiscible organic solvent is utilised. phase. The most widely used polymers are PCL, PLA, and other biodegradable polyesters as well as eudragit. Poly (hydroxybutyrate-co-hydroxybutyrate-co-hydroxybutyrate-co-hydroxybut hydroxyvalerate) (PHBHV) is another option[24]

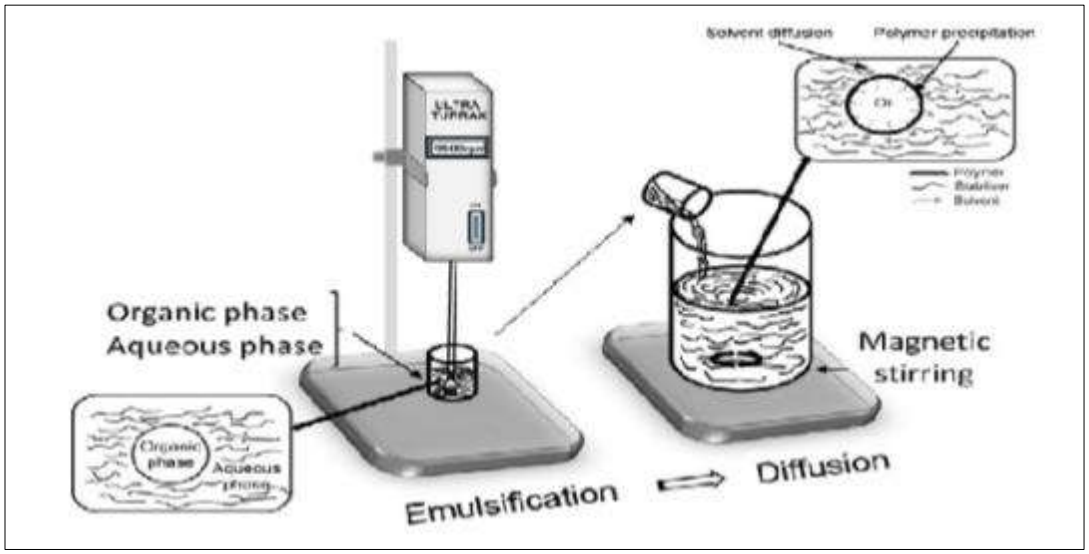

Fig. 5. Emulsion–diffusion

5. Emulsion-coacervation

A combination of two methods is used in this strategy .One of the aqueous phases is the polymer. chitosan, an ethylene oxide di-block co-polymer, or One is a propylene oxide (PEO-PPO) and the other is a propylene oxide (PEO-PPO) sodium tri polyphosphate polyanion In this case, positively charged amino group, technique Negatively charged tripeptides interact with chitosan. coacervates with a size of in polyphosphate Nanometers are the smallest units of measurement.[25]

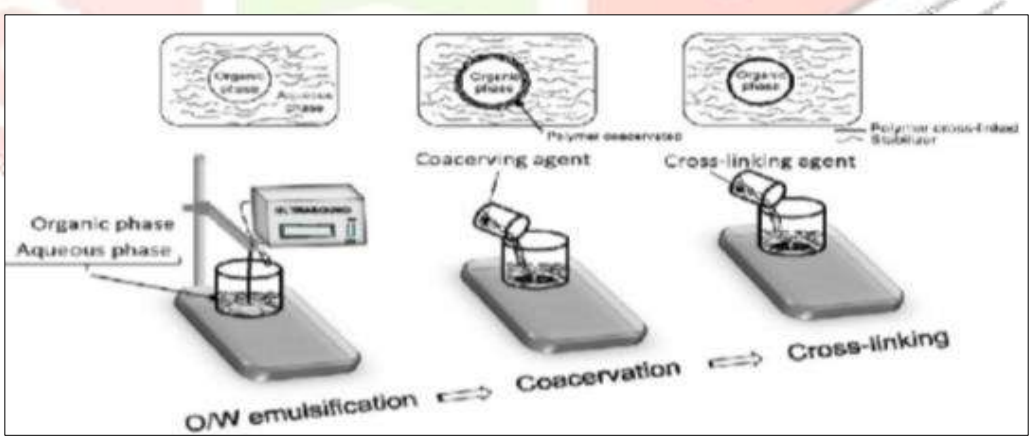

Fig 6. Emulsion –coacervation method

Application of Nanocapsule.

1. Magnetic Nanocapsules for Smart Drug Delivery

By combining peptide-based polymers with modified iron oxide Nanoparticles, researchers have developed Nanoparticles that can be manipulated in a magnetic field and that can respond to changes in pH and other physiologic stimuli.[26] These Nanoparticles, which can be modified to include targeting molecules, could serve

as a versatile, smart platform for delivering drugs and imaging agents to tumors. Diblock copolymers made of peptides to create stimuli-responsive Nanoparticles. The investigators make these polymers by first stringing together short stretches of single amino acids to form peptide blocks.[27] When the investigators mixed the diblock copolymers with iron oxide Nanoparticles modified to be compatible with either water or organic solvents, the components self-assemble into stable Nanoparticles.

2. **Nanocapsules for Self-Healing Materials**

Damage in polymeric coatings, adhesives, microelectronic components, and structural composites can span many length scales. Repair of large-scale damage (e.g. a projectile or blast is difficult and, when possible, requires use of bonded composite patches over the effective area . For smaller scale crack damage, however, a novel method of autonomic repair has been achieved through the use of self-healing polymers.[28]

3. **Food science and agriculture**

Liposomes, spherical bilayer vesicles from dispersion of polar lipids in aqueous solvents, have been widely studied for their ability to act as drug delivery vehicles by shielding reactive or sensitive compounds prior to release. Liposome entrapment has been shown to stabilize encapsulated, bioactivematerials against a range of environmental and chemical changes, including enzymatic and chemical modification, as well as buffering against extreme pH, Temperature, and ionic strength changes.[29]

4. **New cancer weapon-nuclear nanocapsule**

The radioactive compound Astatine, like radium and uranium, emit high velocity alpha particles by theprocedure of radioactive decay, which is about 4,000 Times faster than the beta decay of the emitted electrons, and is most commonly used to treat cancer.[30] The unique combination of the low penetrating power as well as large particle size make the alpha particle unique for Targeting tumor at the single cellular level.[31]

Evaluation of Nanocapsules

1. **Determination of ph**

Nano capsules formulation pH was measured using a digital pH meter at room temperature. Nano capsules Dispersion pH values fall within a range of 3.0-7.5

2. **Structural characterization**

Structural characterization can be done by using field emission scanning electron microscopy (FE-SEM) and Transmission electron microscopy (TEM) to determine the various attributes like shape, size and Surface

morphology. Micrographs of the nano Capsules were obtained using a Phillips Cm 200 Operatedat 20-200 kv while the Fe-SEM was carried out using Hitachi S-4800 FE-SEM equipped with energy dispersion spectrometer.[32]

3. Determination of drug content

Drug content was determined by dissolving 1ml of prepared nanocapsules in 20ml of acetonitrile.Appropriate quantity of sample was then subjected to the UV Spectrophotometer at 232nm. The absorbance for each sample was measured and compared with the Standard.[33]

4. In-Vitro release

In vitro dissolution studies were carried out using USP type 11 dissolution Apparatus. The study was carried out in 100 ml of Buffer (PH 3.0). The nano capsules suspension was placed in dialysis membraneand dipped in Dissolution medium which was kept inert thermostatically at 37±0.50C. The stirring ratewas Maintained at 100 rpm. At predetermined time Intervals 5ml of sample were withdrawn and Assessed for drug release spectrophoto metrically. After each withdrawal 5 ml of fresh dissolution Medium was added to dissolution jar.[34]

Conclusion

Herbal Nanocapsules are the better drug against toe treatment of presents various problems and potential for future study and development of novel improved therapeutics. They can be used in the delivery of active pharmaceutical ingredients (APIs). The applications of nanocapsules can shows the drug delivery system, self-healing materials and also have the various field of Cancer treatment, genetic engineering, cosmetics, cleaning products, as well as food and agriculture. Finally, the Nanocapsules can see has “novel effective drug delivery system” in future.

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