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Short Review Article

A NOVEL DRUG DELIVERY SYSTEM

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Abstract:

Microspheres are free flowing powders consisting of proteins or synthetic polymers which are biodegradable in nature and they ideally have a particle size less than 200 µm. The magnetic targeted drug delivery system is one of the most attractive and promising strategy for delivering the drug to the specified site. Magnetic microsphere is a small particle, with diameter ranging between 1-1000 µm. Magnetic microsphere is occasionally referred to as microparticles. A magnetic Microsphere shows a great potential for future tests in the treatment. Magnetic microspheres as an alternative to traditional radiation methods which uses highly penetrating radiations that is absorbed throughout the body. Magnetic microspheres deliver the drug to the target site with specificity, if modified, and to maintain the desired concentration at the site of interest without unexpected effects. It has limited toxicity and side effects. Magnetic microspheres show two major problems 1.encountered in drug targeting 2.RES clearance. This paper gives an overview of the mechanism, benefits, drawbacks, preparations and applications of magnetic microspheres.

Introduction:

Microspheres are multiparticulate drug delivery systems which are prepared to obtain prolonged or controlled drug delivery to improve bioavailability, stability and to target the drug to specific site at a predetermined rate. They are made from polymeric waxy or other protective materials such as natural, semi synthetic and synthetic polymers. Targeted drug deliveries can be done by two ways i.e. magnetic drug delivery and non magnetic drug delivery. Magnetic microspheres are supramolecular particles that are small enough to circulate through capillaries without producing embolic occlusion (<4µm). Magnetic microsphere is small particle, with diameter in the micrometer range (1-1000 µm). Magnetic microsphere is occasionally referred to as microparticles. Magnetic microspheres are very much important which localizes the drug to the disease site. In this respect, larger amount of freely circulating drug can be replaced by smaller amount of magnetically targeted drug. Controlled drug release and further biodegradation are important for developing successful formulations.

The amount and rate of drug delivery via magnetic responsive microspheres can be regulated by varying (i) Size of microspheres (ii) Drug content (iii) Magnetite content (iv) Hydration state (v) Drug release characteristic of carrier.

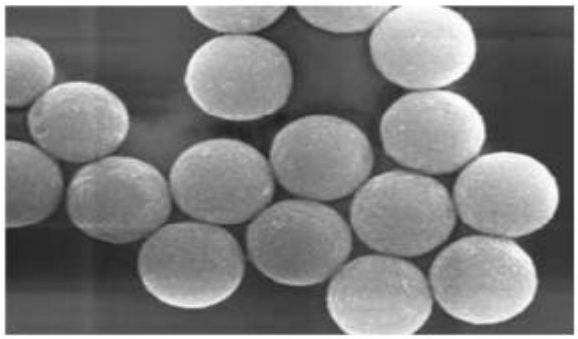


Figure 1: microspheres

Advantages of magnetic microspheres

1. Avoidance of drug toxicity.
2. Adaptable to any part of the body.
3. Controlled drug release within target tissue.
4. Therapeutic responses in target organs.
5. Increased duration of action.
6. First pass effect can be avoided.
7. Method of preparation is simple.
8. Injected into the body using hypodermic needle
9. Improved protein and peptide drug delivery.
10. Improve patient compliance.

Disadvantages of magnetic microspheres

1. Magnetic targeting is an expensive aspect.
2. Advance technique for monitoring
3. Removal once injected is difficult.
4. Unknown toxicity of beads.

Concept and principle behind magnetic targeting

The use of magnetic force for site specific drug delivery by using albumin microspheres contaninng magnetite appears to be a promising strategy. Significant improvements in response can be incorporated and obtained with magnetic albumin microspheres delivery system compared with conventional and nonmagnetic microspheres drug regimens.

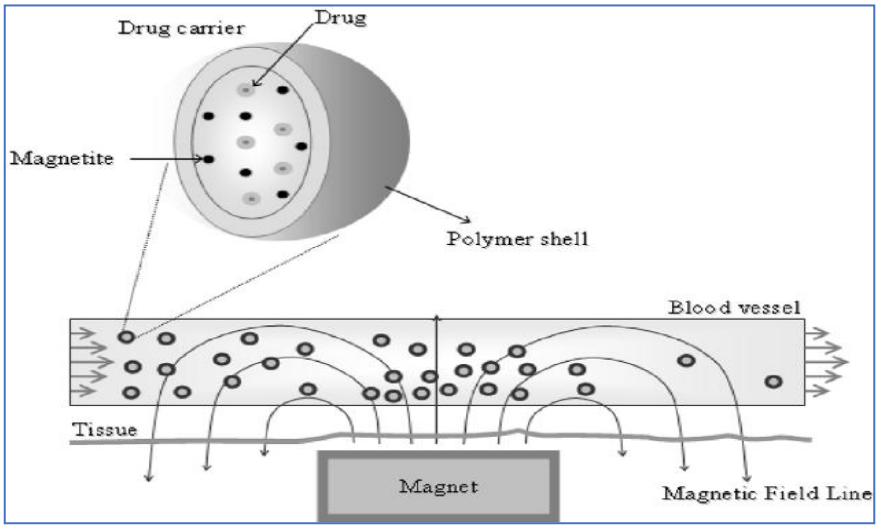


Figure 2: principle of magnetic targeting

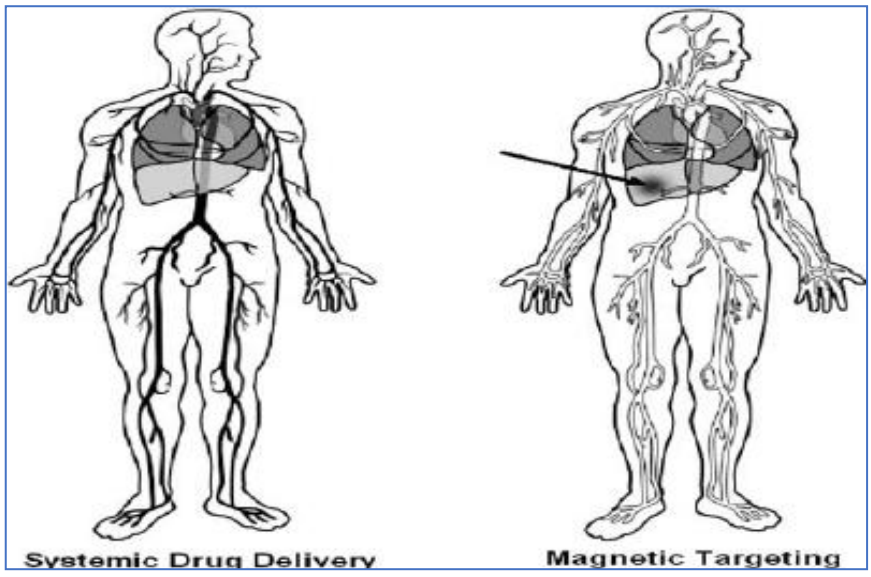


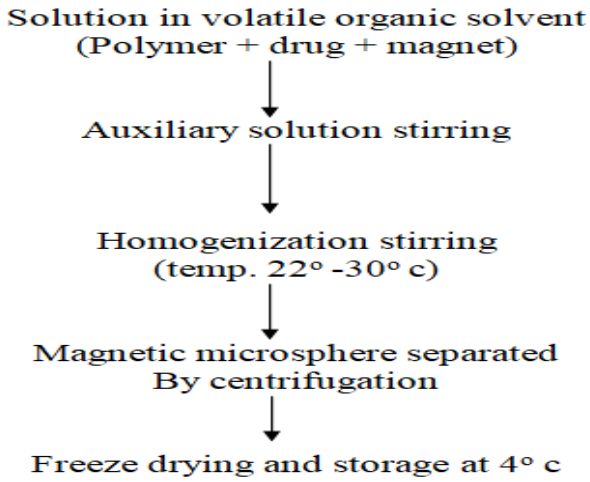
Figure 3: concept of magnetic targeting

Methods of preparation of magnetic microspheres

1) Continuous solvent evaporation method
2) Emulsion Solvent Extraction Method
3) Multiple emulsion method
4) Emulsion Solvent Evaporation Method
5) Phase Separation Emulsion Polymerization Method
6) Inverse phase suspension polymerization method
7) Chemical Precipitation Method
8) Cross Linking Method
9) Suspension Polymerization Method
10) Low Temperature Hydrothermal Method
11) Sonochemical Method
12) Swelling And Penetration Method
13) Photopolymerisation Method
14) Vapour Deposition Method
15) Alkaline Co- Precipitation Method

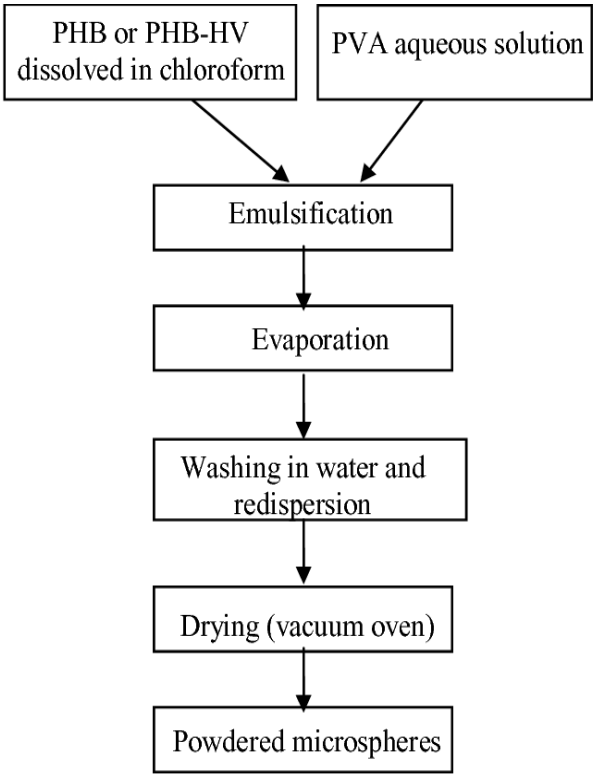
Continuous solvent evaporation method

In this method a solution of polymer, drug, and magnetite should be added into volatile organic solvent. It will form an auxiliary solution on stirring. The suspension of magnetic microspheres is formed when the solution (auxiliary solution) should be maintained at temp. 22^{o}-30^{o}. the suspension should be separated by centrifugation. The separated product is freeze dried and stored at 4^{o}c.



Emulsion Solvent Extraction Method

The preparation involved first the dispersion of an aqueous phase, containing magnetite nanoparticles and a water-soluble homo-polymer, into droplets in an organi c medium using an amphiphilic block copolymer as the dispersant. This was followed by water distillation at a raised temperature from the aqueous droplets to yield polymer magnetite particles. The structure of the particles was then locked in by a reagent being added to crosslink the water-soluble copolymer block and homo-polymer. Since the hydrophobic block of the copolymer consisted of a protected polyester, the removal of the protective moieties from the coronal chains yielded poly (acrylic acid) or other functional polymers to render water dispensability to the spheres and to enable biomolecule immobilization.



Evaluation of magnetic microspheres

1. Particle size and shape

The light microscopy and scanning electron microscopy both can be used for determine the shape and other structure of microscopy. The microspheres

structures can be visualized before and after coating and the change can be measured microscopically.

2. Flow properties

Flow properties such as Density, Hausner's ratio, Angle of repose and Carr's index is calculated to determine the nature of flow.

Density:-

Bulk density:-

Bulk density= bulk volume of microspheres \ total mass of microspheres

Tapped density:-

Tapped density = tapped volume of microspheres {100 times tapped measuring cylinder} \ total mass of microspheres

Hausner Ratio:-

Hausner ratio = tapped density \ bulk density

Angle of repose:-

$\tan \theta = h \setminus r$

Carr's index:-

Carr's index = tapped density – bulk density \ tapped density

4. Drug entrapment capacity:-

Efficiency of drug entrapment can be calculated in term of percentage drug entrapment.

% entrapment = (actual content\ theoretical content) ×100

5. Effect of pH on magnetic microspheres

Measurement of pH sensitive behavior is similar to the measurement of swelling kinetics of the microspheres. It is determined by the equilibrated swelling rate (ESR) at given pH data. ESR of the microspheres is measured by immersing dry and known weight of microspheres into buffer solution with different pH data for at least 1 hr at room temperature. Then the microspheres are removed from the buffer solution and frequently weighed after trapped with a filter paper to remove excess of water on the surface.

ESR = We / Wd

Where:- **We** is the weight of the solution in equilibrated swollen microspheres at each

Predetermined buffer solution with different P^H data.

Wd is the weight of the microspheres at dry state.

Conclusion

Magnetic microspheres are one of the best drug delivery system, it is target specific. Targeted drug delivery system is a effective method and in this system the drug reaches ideally on its desired site. It allows the drug to reach the desired site at a specific time and in required concentration. It has the advantages of avoiding drug toxicity, Controlled drug release within targeted tissue and improve patient compliance. Magnetic microspheres offers great promises for reaching its goals and site specific drug delivery. It does not exert side effects, neither on its way to the therapeutic target, not at the target site, nor during the clearance process. Thus magnetic microspheres have the potential for these objectives.

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