A REVIEW ON MICROSPONGES DRUG DELIVERY SYSTEM

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ABSTRACT:

The application of conventional formulations for topical / transdermal applications such as gels, ointments, creams , lotions etc release the drug called as Active Pharmaceutical Ingredient (API) immediately which lead to irritation and accumulation of large amount of drug due to uncontrolled drug release from the dosage form. The direct application of API have some limitations such as sudden increase in blood plasma levels ,toxicity , allergic reaction and also the API fail to reach the systemic circulation in sufficient amount and time which often results in poor patient compliance. These problems with the conventional dosage forms can be overcome by designing of a novel drug delivery systems with a suitable carrier. The Microsponges approach will be used to overcome the problems with the conventional topical / transdermal drug delivery systems. Microsponges are polymeric delivery systems composed of porous microspheres and can enhance stability, reduce side effects and modify drug release favourably.

Keywords: Microsponge, Topical formulation, Controlled release.

INTRODUCTION:

The Microsponges technology was developed by Won in 1987. The microsponges Delivery system is a patented polymeric system consisting of porous microspheres. They are tiny sponge like spherical particles that consist of a myriad of interconnecting voids within a noncollapsible structure with a large porous surface through which active ingredients are released in a controlled manner. The size of the microsponge's ranges from 5-300µm in diameter and a typical 25µm sphere can have up to 250000 pores and an internal pore structure equivalent to 10 feet in length, providing a total pore volume of about 1ml/g for extensive drug retention.

Microsponge technology has many favourable characteristics, which make it a versatile drug delivery vehicle. Microsponge systems are based on microscopic, polymer-based microspheres that can suspend or entrap a wide variety of substances, and can then be incorporated into a formulated product such as a gel, cream, liquid or powder. MDS can provide increased efficacy for topically active agents with enhanced safety, extended product stability and improvedaesthetic properties in an efficient manner.

Microsponges consist of non-collapsible structures with porous surface through which active ingredients are released in controlled manner. When applied to the skin, the microsponge drug delivery system (MDS) releases its active ingredient on a time mode and also in response to other stimuli such as rubbing, temperature, and pH Microsponges have the capacity to adsorb or load a high degree of active materials into the particle or onto its surface. Its large capacity for entrapment of actives up to 3 times its weight differentiates microsponges from other types of dermatological delivery systems. Mostly microsponge is used for transdermal drug delivery system.

Benefit of microsponge drug delivery system:

1. Enhanced product performance.

2. Extended release.

3. Reduced irritation and hence improved patient Compliance.

4. Improved product elegancy.

5. Improved oil control as it can absorb oil up to 6 times its weight without drying.

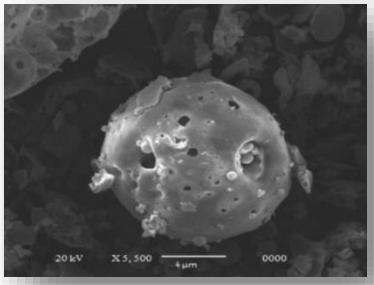
6. Improved formulation flexibility.

7. Improved thermal, physical, and chemical stability.

8. Flexibility to develop novel product forms.

9. Microsponge systems are non-irritating, non-mutagenic, non-allergenic and non-toxic.

Structure of microsponge :



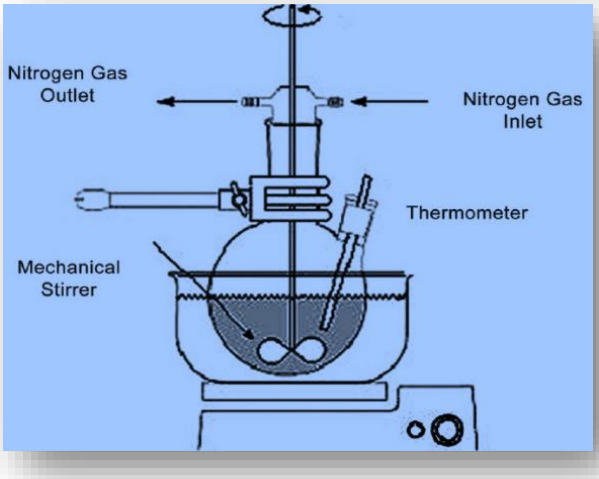
METHOD OF PREPARATION

Micro sponge drug delivery system can be prepared in two ways, one-step process or by two-step process that is liquid-liquid suspension polymerization and quasi emulsion solvent diffusion techniques that is based on physicochemical properties of drug to be loaded.

Liquid–liquid suspension polymerization

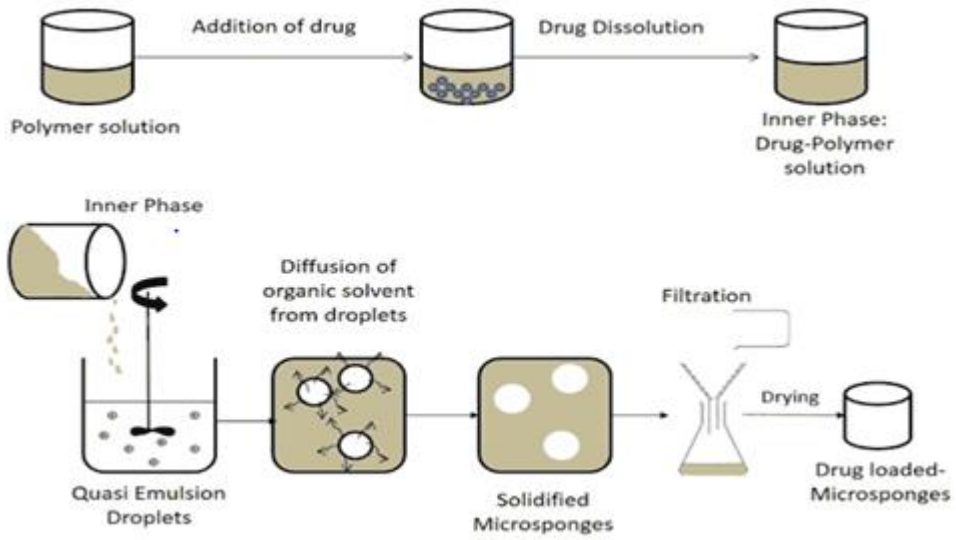
In general, a solution is made comprising of monomers and the functional or active ingredients, which are immiscible with water. This phase is then suspended with agitation in an aqueous phase, usually containing additives, such as surfactants and dispersants, to promote suspension. Once the suspension is established with discrete droplets of the desired size, polymerization is effected by activating the monomers either by catalysis, increased temperature or irradiation. As the polymerization process continues, a spherical structure is produced containing thousands of microsponges bunched together like grapes, forming interconnecting reservoirs.

Once the polymerization is complete the solid particles that result from the process are recovered from the suspension. The particles are then washed and processed until they are substantially ready for use. The microsponge products can be made using styrene and divinylbenzene or methyl methacrylate and ethylene glycol dimethacrylate as starting materials.



Quasi-emulsion solvent diffusion

To prepare the inner organic phase, polymer is dissolved in suitable organic solvent . Next, the drug is added to the solution and dissolved under ultrasonication at 35°C. The inner phase is poured into the emulsifier solution in water (outer phase). Following 60 minutes of stirring, the mixture is filtered, to separate the microsponges. The microsponges are dried in an air-heated oven at 40°C for 12 hours.



RELEASE MECHANISM

The active ingredient entrapped in the microsponges may release by 4 mechanisms:

A) Pressure Triggered Release Mechanism: The entrapped drug is released from microsponge when they are pressurized or rubbed. The amount released depends upon the size and number of pore available on the sponge .

B) Temperature triggered Release Mechanism: The active ingredients loaded in microsponges are viscous at storage temperature. On the application onto the skin by the means of rubbing or increase in temperature reduces the viscosity the active drug may flow out vigorously the skin. Sometimes by increasing the temperature of the skin may enhance the fluidity of drug. The release of the drug is easily modulated by changing the temperature .

C) pH Triggered Release Mechanism: In this mechanism microsponge is coated with the pH-dependent polymers. On the specific pH these polymers either swelled or leached out from the microsponges. After leaching of pH-dependent polymer the drug released from the microsponges. Coating of the microsponge increases the application of drug delivery to site-specific delivery.

D) Solubility Triggered Release Mechanism: When water-soluble drug loaded in microsponge it release only in presence of water. The rate of drug release from microsponge can be triggered by the amount of aqueous medium .

CHARACTERIZATION OF MICROSPONGES

Various evaluation tests were performed to evaluate the prepared formulations of microsponges:

A)Total Yield Percentage and Loading Efficiency: The total yield percentage of prepared Microsponge is calculated by the formula:

$$\% \text{ Yield} = \text{Actual weight of product/total weight of product} \times 100$$

B) Scanning Electron Morphology (SEM): SEM by using the SEM the morphology surface topography and particle size diameter can be easily studied.

C) Characterization of Pore Structure: Pore volume and diameter are vital in controlling the intensity and duration of effectiveness of the active ingredient. Pore diameter also affects the migration of active ingredients from microsponges into the vehicle in which the material

is dispersed. Mercury intrusion porosimetry can be employed to study effect of pore diameter and volume with the rate of drug release from microsponges. Porosity parameters of microsponges such as intrusion- extrusion isotherms pore size distribution, total pore surface area, average pore diameters, interstitial void volume percent porosity, percent porosity filled, shape and morphology of the pores, bulk and apparent density can be determined by using mercury intrusion porosimetry.

D) In-vitro Dissolution Studies: The dissolution pattern of the active ingredient of the microsponge can be estimated by USP dissolution apparatus. 900 ml of stimulated solution at 37 ± 0.5 ºC are used to determine to dissolution behavior of the drug.

E) Stability Studies: The accelerated stability studies are carried out according to guidelines given by the International Council of Harmonization (ICH guidelines). The formulations are tested for stability at 50 ± 2 ºC, 250 ± 2 ºC/ 60 ± 5 RH, 400 ± 2 ºC/ 75 ± 5 RH. Formulations are stored in glass bottles/vials and are evaluated after every 15, 30, 45 days for their physiochemical characteristics.

F) Drug-Polymer Compatibility Studies: The sample of drug, excipients, and mixture of drug with excipients (binary (1:1) powder mixtures prepared by triturating drug with the individual excipients) was sealed in vials and kept at room temperature for not less than one month and then samples were analyzed by DSC, XRD, and FTIR.

APPLICATIONS OF MICROSPONGE DELIVERY SYSTEM

ACTIVE AGENTS	APPLICATIONS
Anti-acne	Maintained efficacy with decreased skin irritation and sensitization.
Anti-dandruffs	Reduced unpleasant odour with lowered irritation with extended safety and efficacy.
Anti-fungals	Sustained release of actives.
Anti-inflammatory	Long lasting activity with reduction of skin allergic response and dermatoses.
Antipruritis	Extended and improved activity.
Rubefacients	Prolonged activity with reduced irritancy greasiness and odour.
Skin de-pigmenting agents	Improved stabilization against oxidation with improved efficacy and aesthetic appeal.

CONCLUSION

The microsponge delivery system is a unique technology for the controlled release of macroporous beads, loaded with an active agent, offering a potential reduction in side effects while maintaining their therapeutic efficacy. The microsponge drug delivery system

offers entrapment of its ingredients and is believed to contribute toward reduced side effects, improved stability, increased elegance and enhanced formulation flexibility. In addition, numerous studies have confirmed that microsponge systems are non-irritating, non-mutagenic, non-allergenic, and non-toxic. This technology is being used currently in cosmetics, over-the-counter skincare, sunscreens, and prescription products. This kind of drug delivery technology may lead to a better understanding of the healing of several diseases. Hence, Microsponge-based drug delivery technology is likely to become a valuable drug delivery matrix substance for various therapeutic applications in the future.

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