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DRUG DELIVERY FROM MICROSPONGES: A REVIEW ARTICLE

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Abstract: Micro sponges are micro-porous particles, used mainly for topical and recently for oral administration. Micro sponges have many advantages which make it a versatile drug delivery system. Micro sponges can suspended or entrap a wide variety of substances and then be incorporated into a formulated product such as a gel, cream, liquid, or powder. Moreover, they may enhance stability, reduce side effects and modify drug release related to its porous structure which allows the active ingredient to sustain over time. The aim of this article is to provide details about micro sponges including the method of preparation, characterization, mechanism of drug release from micro sponges, different formulation and process factors, and a few applications about micro sponges which are either proven or under research.

Keywords: Micro sponges, drug delivery, porous particles, topical applications.

Introduction: With advances in biotechnology, genomics, and combinatorial chemistry, a wide variety of new, more potent and specific therapeutics are being created. Because of common problems such as low solubility, high potency, and/or poor stability of many of these new drugs, the means of drug delivery can impact efficacy and potential for commercialization as much as the nature of the drug delivery. Indeed, different drug delivery systems designed to provide a therapeutic agent in the needed amount, at the right time, to the proper location in the body, in a manner that optimizes efficacy, increase compliance and minimize side effects. Micro sponges are polymeric delivery system composed of porous microspheres which having a particle size range of 5-300 μm with a capability to entrap a wide range of active ingredients and are used as a carrier for topical drug delivery.

Preparation of micro sponges

Drug loading in micro sponges can take place in two ways, one-step process (Liquid-liquid suspension polymerization) or by two-step process (Quasi-emulsion solvent diffusion method) which are based on physicochemical properties of a drug. If the drugis typically an inert non-polar material, it will create a porous structure and this called Porogen. Porogen drug, which neither hinders the polymerization nor becomes activated by it and stable to free radicals are entrapped by the one-step process.

Liquid-liquid suspension polymerization:

In general, the monomers are first dissolved along with active ingredients in a suitable solvent solution of monomer. Then, it 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 initiated by activating the monomers either by catalysis or by increasing temperature or irradiation. As the polymerization process continues, a spherical structure is produced containing thousands of micro sponges bunched together like grapes, forming interconnecting reservoirs (Hainey et al., 1991). Once the polymerization completes the solid particles are washed and stored.

Quasi-emulsion solvent diffusion

When the drug is sensitive to the polymerization conditions, the two-step process is used. In general, an active substance with a different drug: polymer ratios were dissolved in the organic solvent (inner phase). Then, the obtained solution was poured into a polyvinyl alcohol solution (external phase) with continuous stirring in order to evaporate the solvent, then the

mixture is filtered to separate the micro sponges. The obtained micro sponges are dried and stored in desiccators to ensure the complete removal of residual content. Mechanism of drug release from micro sponges Drug release from micro sponges occurred overtime in response to one or more external triggers such as (temperature, pressure, pH, and solubility). Pressure rubbing or pressure applied can release active ingredients from micro sponge onto the skin.

Temperature

The flow rate of the active ingredient from micro sponges was affected by temperature change. With increased skin temperature, the flow rate is also increased and therefore release is also enhanced.

pH : Triggering the pH-based release of the active ingredient can be occurred by modifying the coating on the micro sponges. Solubility Micro sponges loaded with hydrophilic active ingredients such as antiseptics and anti-per spirants will be released in the presence of aqueous media. The release can also be achieved by diffusion but taking into consideration, the partition coefficient ingredient between the micro sponges and the external system.

Physical characterization of micro sponges:

Production yield (PY) The PY (%) of the TMM-loaded micro sponges was determined by calculating precisely the beginning weight of the compounded materials and the ultimate weight of the micro sponges, according to the following equation

PY (%) = the ultimate weight of micro sponges (mg) (The beginning weight (polymer + drug) (mg)) x 1004.2. Particle size Particle size examination of micro sponges could be carried out by laser light diffracts meter or any suitable methods. The values (d50) can be expressed for all formulations as a mean size range. Particles larger than 30 μm can impart gritty feeling and hence particles of size 10 to 25 μm are preferred to use in a final topical formulation.4.3. Entrapment Efficiency (E.E.) the obtained loaded-micro sponges were mixed with a suitable amount of phosphate buffer saline (PBS, pH= 7.4) or any other suitable solvent to allow drug extraction with continuous shaking. Then, the drug content was determined by measuring the absorbance at the predetermined wavelength of the drug. The E.E. (%) was calculated related to the following equation:

E. (%) = the actual drug content in micro sponges Theoretical drug content x 1004.4.

Morphology and surface topography of micro sponges:

Micro sponges can be coated with gold-palladium under an argon atmosphere at room temperature. Then the scanning electron microscopy was used to study the surface morphology of the micro sponges. Compatibility studies Thin-layer chromatography and Fourier Infra-red spectroscopy can be used to estimate the compatibility between drugs and excipients. Drug crystallinity can be studied by X-ray diffraction and Differential Scanning Colorimetry (Moin etal., 2016).Dissolution studies Dissolution apparatus USP with certain modifications was used for studying the dissolution profile of the loaded microsponges.The dissolution medium is selected by considering the solubility of the drug to ensure sink conditions. After different time intervals, samples were withdrawn from the dissolution medium and analyzed by a suitable analytical method. Then, the kinetics studies were done by fitting the in-vitro drug release data to different models to determine the kinetics of drug release from the prepared micro sponges (Bruschi, 2015). Effect of different formulation and process variables on physicochemical properties of micro sponges. Polymer or monomer composition Micro sponge size, drug loading and polymer design regulate drug release from microsponges.The polymer composition can affect the partition coefficient of the entrapped drug between the vehicle and the micro sponge system.

Applications of Micro sponges

Anti-acnee.g. Benzoyl peroxide Maintained efficacy with decreased skin irritation and sensitization. 2. Anti-inflammatory e.g.hydrocortisone long lasting activity with reduction of skin allergic response and dermatoses. 3. Anti-fungals Sustained release of actives. 4. Anti-dandruffse.g. Zincpyrithione, selenium sulfide Reduced unpleasant odour with lower edirritation with extended safety and efficacy. 5. Antipruritics Extended and improved activity. 6. Sunscreens Long lasting product efficacy, with improved protection against sunburns and sun related injuries even at elevated concentration.

CONCLUSION:

MDS has become highly competitive and rapidly evolving technology and more and more research are carrying out for cost-effective therapy. MDS holds a promising future in various pharmaceutical applications in the coming years as they have

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unique properties like enhanced product performance and elegancy, extended release, reduced irritation, improved thermal, physical, and chemical stability so flexible to develop novel product forms. MDS which is originally developed for topical delivery of drugs like anti-acne, anti-inflammatory, anti-fungal, anti-dandruffs, antipruritics, rubefacients etc. Now a day it can also be used for controlled oral delivery of drugs using bioerodible polymers, especially for colon specific delivery. It provides a wide range of formulating advantages. Liquids can be transformed into free flowing powders. Incompatible ingredients with prolonged stability without use of preservatives can be developed. Safety of the irritating and sensitizing drugs can be increased and programmed release can control the amount of drug release to the targeted site. Micro sponge delivery systems that can precisely control the release rates or target drugs to a specific body site have an enormous impact on the health care system. Micro sponges constitute an important part by virtue of their small size and efficient carrier characteristics. New classes of pharmaceuticals, biopharmaceuticals (peptides, proteins and DNA-based therapeutics) are fueling the rapid evolution of drug delivery technology.

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