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Microsponges - A New Hope for Drug Delivery System

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Abstract

Microsponge drug delivery is one of the most effective drug delivery system and also a modern technology which has been used for both oral and topical controlled drug delivery system. They are porous microspheres. Because of the porous nature it can entrap the poorly soluble drugs and provide targeted drug delivery also. Microsponges can be loaded into different formulations for the oral and topical use.

Key words: Microsponge, Microsphere, Controlled drug delivery, Targeted drug delivery

INTRODUCTION

Microsponge technology arises from the experienced difficulty of conventional formulation in releasing poorly soluble active ingredients especially in the case of extended release dosage form. Is microsponges are introduced into the topical drug products to avoid direct release of drug to the systemic circulation. Anyway the oral drug delivery through the microsponges is also an unavoidable drug delivery system. Currently various products of microsponges are marketed for the topical application. Microsponges have numerous interconnected pores. From the pores itself the drug are released to the specific site and make the action of drug. Microsponges are pored microspheres. The active agents are entrapped in the porous surface and provide extended release of drug. Various studies are connected for oral drug delivery for colon targeting microsponges. It also has the capacity to reduce side effects, improved stability, and also enhance formulation flexibility.

Microsponge formulations are versatile carrier system, they are stable over the range of physiological pH and also they are stable over the range of 130^0 C. Microsponges limits the penetration of the bacteria, with the average pore size 0.25µm from this it act as a self sterilizing formulation. The porous surface helps the dissolution media into the drug loaded concentration and also they enhance the solubility of poorly soluble drug. In the case of topical drug delivery of microsponges reduce accumulation of active agents in to epidermis and dermis towards this avoids the irritation of skin. In oral drug delivery floating microsponges provide prolonged release of drug by escaping from the gastric emptying procedure and make the drug in a comfort zone. The prolonged release conditions reduce the toxicity and allergic reactions.

Richard Won scientist developed microsponges. The bead diameter is in the range of 5-100 µm. The human sin average size is 5 microns. The imperishable spheres are unable to pass through the skin. The active agents in the pores are slowly release into the skin. The polymers used in the preparation of microsponges are responsible for the cage formation of microsponges. The most widely used polymers for the preparation are Eudragit RS-100, Eudragit RS PO, Eudragit S-100, polyactide –co-glycolic acid, polyhydroxyl butyrate, polylactic acid and polydivinyl benzene. [1]

Figure 1: Structure of microsponge

METHOD OF PREPARATION OF MICROSPONGES

In general, the microsponges are prepared by two methods that is, liquid-liquid suspension polymerization and quasi emulsion solvent diffusion, but recently some novel techniques are developed and also check out the advantages and disadvantages of these methods of preparations.

Liquid –liquid suspension polymerization

The polymerization process continues the formation of a reservoir type of system with the spherical structure. Polymerization starts as formation of chain monomers. As a result of cross-linking between chain monomers, ladders are formed. Folding of monomer ladders to form spherical particles. Agglomeration of these micro spheres leads to the production of bunches of micro spheres. Binding of bunches of microspheres to produce micro sponges. The reaction was carried out in a round bottom three necked flasks. A stirrer, a water condenser and a thermometer is also fitted to the flask. Monomers with non-polar drug solutions are prepared and to this preparation aqueous phase containing surfactant and dispersant was added. [2]

Quasi emulsion solovent diffusion

The internal phase consisted of Drug, volatile Solvent, polymer and TEC, which was added at an amount of 20% of the polymer in order to facilitate the plasticity. An

external phase containing distilled water and PVA. At first, the internal phase was prepared and added to the external phase at room temperature. After emulsification, the mixture was continuously stirred for 2 hours. Then the mixture was filtered to separate the microsponges. The product was washed and dried by hot air oven at 40°C for 12 hours. [3]

Water in oil in water emulsion solvent diffusion

In this method an internal aqueous phase containing an emulsifying agent was dispersed in organic polymeric solution. This water in oil emulsion was again dispersed in external aqueous phase containing PVA to form a double emulsion. In this method both water- soluble and water insoluble drugs can be entrapped. [4]

Oil in oil emulsion solvent diffusion

According to this method, the emulsion was prepared as the internal phase consists of volatile organic liquid. In most of the preparation dichloromethane is used as the volatile solvent. And the polymer used in this is polyactide glycolic acid, span 85 as external phase. The internal phase was added to the dispersion medium in dropwise with continuous stirring to get the microsponge. [5]

Addition of porogen

For this, the internal phase consists of porogen like hydrogen peroxide or sodium bicarbonate. The porogen was dispersed in the polymeric solution to form a uniform dispersion system, and this was redispersed in aqueous phase containing PVA. The effect of adding hydrogen peroxide leads to the formation of interconnected pores with diameters from ranges 5 to 20 µm. [6]

Lyophilisation

In this method, the microspheres are converted into porous microspheres by quick removal of solvent leads to porous microspheres. It is done by using chitosan hydrochloride solution. The microspheres are incubated in this solution and then lyophilized. There is cracking and shrinking of microparticles may occur, due to quick removal of solvent. [7]

Vibrating orifice aerosol generator method

Vibrating orifice aerosol generator method was mostly for the lipid bilayered mesoporous silica particles preparation. The core particle is prepared by tetraethylorthosilicate, ethanol, water and dilute hydrochloric acid were refluxed to prepare stock solution. And this solution was diluted with the solvent containing surfactant and continues strring got monodisperse droplets. The formed microspheres are encapsulated in the lipsomes. [8]

These are the few methods reported for the microsponge preparation. All of the above methods have its own different way of preparation, From this most of the microsponges are prepared by using Quasi Emulsion Solvent Diffusion, compare with other methods quasi emulsion solvent diffusion has least disadvantages for the prepared product.

CHARACTERIZATION OF MICROSPONGES [9]

Evaluation studies are futher carried out for the prepared microsponges for find out the

- Particle size
- Production yield
- Loading efficiency
- Surface topography
- *In vitro* release studies

Particle size

Particle size of microsponges is evaluated by optical microscope or electron microscope. The size of particle affects the formulation performance. The factors affecting the particle size are drug:polymer ratio and also the emulsifying agents concentration. When drug polymer ratio increases there is decrease in particle size, increase in emulsifying agents concentration leads to larger particle size. Particle size was determined with an optical microscope using a calibrated ocular and stage micrometer. A minute quantity of microsponges was spread on a clean glass slide with a drop of liquid paraffin and a cover slip is placed on it. The average particle size was calculated by measuring 100 particles of each batch. [9]

Production yield

The drug polymer ratio also affects production yield, an increase in drug:polymer ratio leads to increase in production yield also [9] . The production yield can be calculated by

Production yield = Practical quantity/ Theoretical quatity x 100

Loading efficiency

Drug loading in microsponge depending on the physicochemical properties of the drug. There are two ways for the drug loading active and passive loading. Passive loading is most efficient. Increase in drug: polymer ratio leads to increase in drug loading efficiency [9] . The loading efficiency is calculated by

Loading efficiency = Practical drug loading/Theoretical drug loading x 100

Surface topography

The various techniques have been used in surface topography they are, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) etc. SEM is widely used for the prepared microsponges. [9]

In vitro release studies

It is carried out using dissolution apparatus USP XXIII equipped with a modified basket consisted of 5µm stainless steel mesh. Dissolution rates were measured at 37^0C under 150 rpm speed. The medium for dissolution is selected according to the solubility of active ingredients. Samples were withdrawn from the dissolution medium and analyzed by the sutiable analytical method. [10]

CONCLUSION

Microsponge drug delivery system holds a promising opportunity in various pharmaceutical applications in the upcoming future as it has unique properties like enhanced product performance and elegancy, extended release, improved drug release profile, reduced irritation, improved physical, chemical and thermal stability which makes it flexible to develop novel product forms.

REFERENCE

1. Atmaram P, Pawar, Aditya P, Gholap, Ashwin B, Kuchekar C et al. Formulation and evaluation of optimized oxybenzonemicrosponge gel for topical delivery. *J of drug delivery.* 2015;*[7]*:12-48.
2. Won R. *Two step method for preparation of controlled release formulation*. United States patent number. US5145675; 1992.
3. Jelvehgari MR, Siahi-Shadbad S, Azarmi GP, et al. The microsponge delivery system of benzoyl peroxide: preparation, characterization and release studies. *Int J Pharm* 2006;*[308]*:124-32.
4. Maiti S, Kaity S, Ray S, et al. Development and evaluation of xanthan gum-facilitated ethyl cellulose microsponges for controlled percutaneous delivery of diclofenac sodium. *Acta Pharm* 2011;*[61]*:257-70.
5. Zaki Rizkalla CM, Latif Aziz R, Soliman II. In vitro and in vivo evaluation of hydroxyzine hydrochloride microsponges for topical delivery. *AAPS PharmSciTech* 2011;*12[3]*:989-1001.
6. Bae SE, Son JS, Park K, et al. Fabrication of covered porous PLGA microspheres using hydrogen peroxide for controlled drug delivery and regenerative medicine. J Control Release 2009;*[133]:*37-43.
7. Liu LS, Liu SQ, Ng SY, et al. Controlled release of interleukin-2 for tumour immunotherapy using alginate/chitosan porous microspheres. *J Control Release* 1997;*[43]*:65-74.
8. Lopez GP, Buranda T, Gopalaraju VRR, et al. *Biologically functionalized porous microspheres.* US2004005352; 2004.
9. Sha-Sha Li, Guo-Feng Li, Li Liu, Xias Jiang, Bin Zhang, Zhi-Gang Liu et al. Evaluation of paeonol skin-target delivery from its microsponge formulation: *In vitro Skin Permeation and In vivo Microdialysis, Plosone.* 2013; *[8]:*789-98.
10. Pushpa, Kumari, Shashi Kiran Mishra. A comprehensive review on novel microsponges drug delivery approach. *Asian, J. Pharm. Cli. Res*. 2016; *[9]:*25-30.