



A SMART APPROACH FOR NOVEL DRUG DELIVERY SYSTEM “MICROSPONGES”

Virendra Shiva¹, Yogita Tyagi², Hiba Parveen³, Praveen Kumar Ashok⁴

Gyani Inder Singh Institute of Professional Studies, Dehradun

Abstract

A microsp sponge's delivery system is a profoundly cross-connected, non-collapsible, permeable, polymeric microsphere, polymeric framework comprising of permeable microspheres. Polymeric microspheres having molecule size range from 5 to 300 μm that can hold large amount of active ingredients and release them over extended time

They are profoundly powerful, consistent, non-aggravation, nontoxic, non-hypersensitive, non-mutagenic and furthermore least side effects. Microsp sponge's preparations are steady over a pH range of 1 to 11. Microsp sponge's are consistent at temperature up to 130 $^{\circ}\text{C}$ reasonable with most solvents and polymers.

This delivery system gives extended discharge with decreased side effect, improved holding capacity, improved product, physical and compound strength during stability.

Different polymers like Eudragit RS100, ethyl cellulose, polystyrene, PHEMA (Poly (2-hydroxyethyl methacrylate), and so on can be used in shaping microsponges.

Keywords: Microsponges, Microspheres, Polymer, Non-toxic, Controlled Release

Introduction

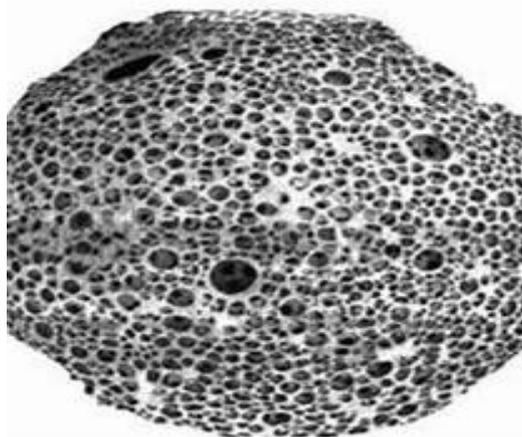
For the treatment of skin disease, topical drug delivery system plays an important role. Conventional drug delivery system provides great side effects due to overmedication or undermedication. Microsponges drug delivery system provide controlled release of the drug and provide the drug into epidermis in controlled manner, that increase the drug contact time in epidermis with simultaneous minimize the transdermal penetration into the systemic circulation is required to control the side effect.^{1,8}

It is an exceptional innovation for the controlled release of effective specialists and comprises of miniature porous beads, typically 10-25 microns in diameter, loaded with drug. Their high level of cross-connecting brings about particles that are insoluble, idle and of adequate solidarity to face the high shear usually utilized in formulation of creams, gels, and powder, etc. Their qualities include is the adsorb or hold a high level of drug into the molecule and on to its surface.²

The Microsp sponge Drug Delivery System enjoys upper hands over different advancements like microencapsulation and liposomes. Microcapsules can't ordinarily control the delivery pace of actives.³

They are little wipe like circular particles that comprise of a bunch of interconnecting voids inside a non-folding design with a huge porous surface through which API are delivered in a controlled way. The size of the microsp sponge's reaches from 5-300 μm in diameter and a typical 25 μm circle can have up to 2,50,000 pores and an inside pore structure identical to 10 feet long, giving a complete pore volume of around 1ml/g for broad medication holding efficacy.⁴⁻⁵

In addition, they might upgrade steadiness, diminish aftereffect and change drug discharge well. Microsponge innovation has numerous good qualities, which make it a flexible drug delivery system. Microsponge Drug Delivery System can provide increased efficacy for topically actives agents with enhanced safety, extended product stability and improved aesthetic properties in an efficient manner.^{5,7,8,9}



1. Picture of Microsponges¹



2. Picture of Microsponges

Attributes of Microsponges^{9,10,11}

1. Microsponge formulations are stable over range of pH 1 to 11.
2. Microsponge formulations are stable at the temperature up to 130 0C.
3. Microsponge formulations are compatible with most vehicles and ingredients
4. Microsponge formulations are self-sterilizing as their average pore size is 0.25 μ m where bacteria cannot penetrate.
5. Microsponge formulations have higher payload (50 to 60%), still free flowing and can be cost effective.

ADVANTAGES^{12,13}

- 1) Advanced oil control, absorb up to 6 times its weight without drying
- 2) Improved product elegancy
- 3) Extended release
- 4) Reduced irritation formulas
- 5) Allows novel product form
- 6) These are non-irritating, non-mutagenic, non-allergenic and non-toxic.
- 7) Improved product aesthetics
- 8) Extended release, continuous action up to 12 hours
- 9) Reduced irritation, better tolerance means broader consumer acceptance
- 10) Improves stability, thermal, physical and chemical stability
- 11) Allows incorporation of immiscible products
- 12) Improves material processing e.g. liquid can be converted to powders
- 13) Improves efficacy in treatment.

CHARACTERISTICS OF MATERIALS THAT IS ENTRAPPED IN MICROSPONGES^{14,15}

- 1) It should be either fully miscible in monomer or capable of being made miscible by addition of small amount of a water immiscible solvent.
- 2) It should be water immiscible or at most only slightly soluble.
- 3) It should be inert to monomers hence it can react with other Excipient in formulation
- 4) The solubility of actives in the vehicle must be limited to avoid cosmetic problems; not more than 10 to 12% w/w microsponges must be incorporated into the vehicle. Otherwise, the vehicle will deplete the microsponges before the application.
- 5) The round structure of microsponges should have non-collapsible voids.
- 6) It should be stable in contact with polymerization catalyst and conditions polymerization.

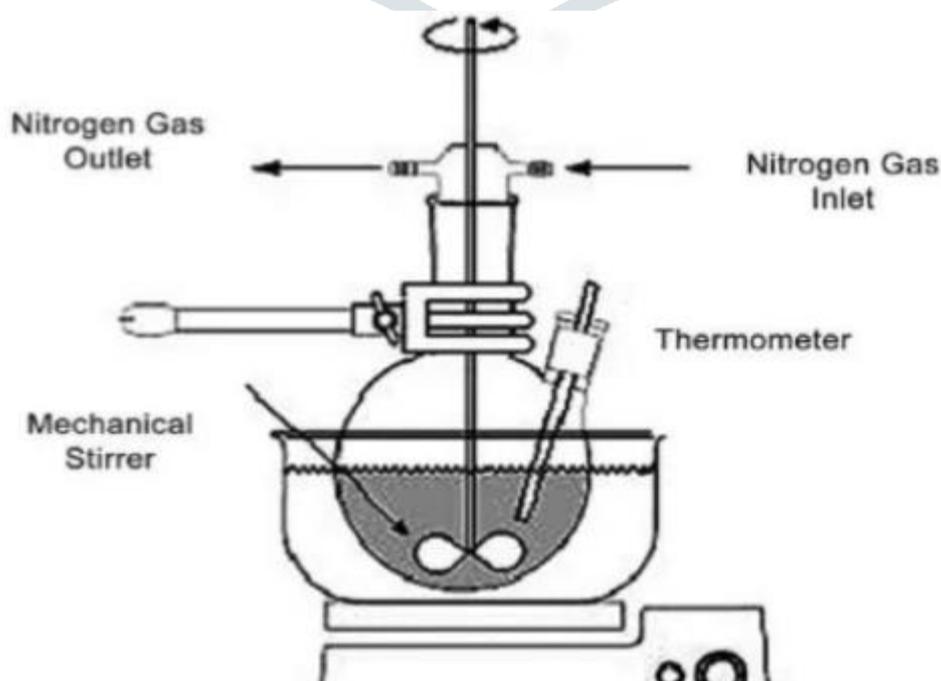
PREPARATION OF MICROSPONGE:

Drug can be loaded into microsponges by two methods, one-step process or by two-step process as discussed in **liquid-liquid suspension polymerization** and **quasi emulsion solvent diffusion techniques** which are based on physicochemical properties of drug to be loaded.

1) **Liquid-liquid suspension polymerization**^{16,17,18}

In this Liquid-liquid suspension polymerization method, the porous microspheres are prepared by suspension polymerization method in liquid-liquid systems. In their preparation, the monomers are first dissolved along with active ingredients in a suitable solvent solution of monomer and are then dispersed in the aqueous phase, which consist of additives (surfactant, suspending agents, etc.). The polymerization is then initiated by adding catalyst or by increasing temperature or irradiation. The various steps involves in the preparation of microsponges are summarized as

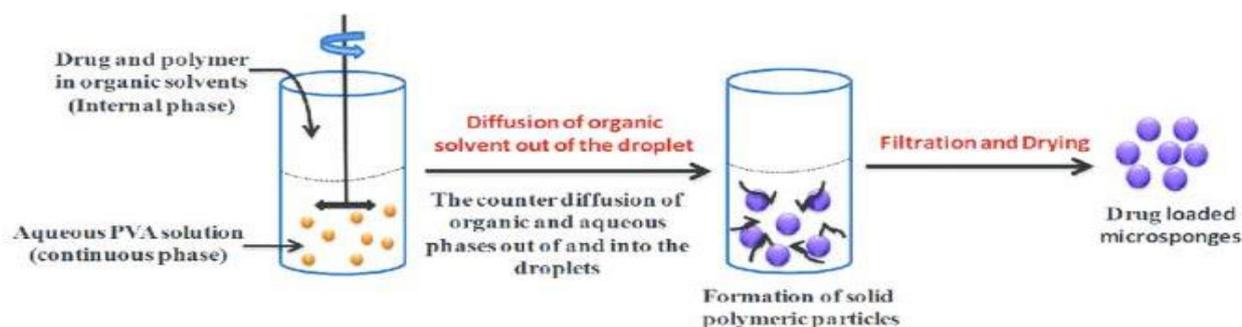
- Choice of monomer or mix of monomers
- Development of chain monomers as polymerization starts.
- Developments of stepping stools because of cross connecting between chain Monomers.
- Collapsing of monomer stepping stool to frame round particles-Agglomeration of microspheres, which lead to development of lots of microspheres.
- Restricting of packs to frame microsponges



Reaction container for preparation of Microsponges by Liquid-Liquid solvent diffusion method

2) Quasi-emulsion solvent diffusion method^{19,20,21}

This is the most generally use strategy for the preparation of microsponges. Because of effortlessness of this technique generally scientists utilize this strategy. In this strategy two stage were ready , inner organic and external aqueous stage . the internal stage is ready by dissolving the polymer in appropriate solvent followed by addition of Active material . the second external aqueous stage is ready by dissolving PVA in water. The internal stage mixed with external stage dropwise by constantly mixing for 2 hours. Then the solution is filtered to separate microsponges and then dried in oven or tray dryer for 12 hours at 40°C or 48 Hours at room temperature.



Quasi-emulsion solvent diffusion method

Evaluation parameters of Drug loaded microsponges^{22,23}

1) Compatibility Study²⁴

Compatibility of drug with reaction adjuncts can be studied by thin layer chromatography (TLC) and Fourier Transform Infrared spectroscopy (FT-IR). Effect of polymerization on crystallinity of the drug can be measured by powder X-ray diffraction (XRD) and Differential Scanning Calorimetry (DSC).

2) Microsponges Drug loading efficiency²⁵

The loading efficiency (%) of the microsponges can be determined according to the following equation:

$$\text{Loading efficiency} = \frac{\text{Actual Drug Content in Microsponge}}{\text{Theoretical Drug Content}} \times 100$$

3) Particle size determination²⁶

Laser light diffractometry or some other appropriate techniques are utilizing to particle size examination of loaded and dumped microsponges. The values can be communicated for all formulations, size range. Combined rate drug discharge from microsponges of various microsponges particle size will be plotted against time to concentrate on impact of particle size on drug release. Particles bigger than 30 μm can give coarse inclination and consequently particles of sizes somewhere in the range of 10 and 25μm are liked to use in last effective.

4) Visual Inspection²⁷

Microsponges can visually inspected by their colour, odour & appearance.

References:

1. Karthika R, Elango K, Ramesh Kumar K, Rahul K. Formulation and evaluation of lornoxicam microsponge tablets for the treatment of arthritis. Int J Res Article Pharm Innovations 2013;3:29-40.

2. Patel UB, Patel HM, Shah CN, A review- Recent research on microsp sponge a novel new drug delivery system, International Journal of Advances in pharmaceuticals, 2018; 07 (03): 10-16
3. Kaundal A, Bhatia R, Sharma A, Sukrial P. A review on microsponges drug delivery system. Int J Adv Pharm 2014;4:177-81
4. Jagtap SC, Karale AA, Microsp sponge : A novel topical drug delivery system, Journal of drug delivery research 2014; 3 (4): 2319-1074.
5. Saroj Kumar Pradhan, microsponges as the versatile tool for drug delivery system, international journal of research in pharmacy and chemistry, 2011, 1(2)
6. Woo Yeup Jeong, Mina Kwon, Hye Eun Choi and Ki Su Kim, Recent advances in transdermal drug delivery systems: a review, Biomaterial Research 2021, 25(24).
7. Nanda S, Kaur M, Sood Nikhil, Microsp sponge drug delivery system: an overview, World Journal of pharmacy and Pharmaceutical science, Volume 2, Issue 3, 1032-1043.
8. Aity S, et al., Microsp sponge: A novel strategy for drug delivery system. J Adv Pharm Technol Res, 2010. 1(3): p. 90-283.
9. Chadawar V, and J. Shaji, Microsp sponge delivery system. Curr Drug Deliv, 2007 4(2); 9-123.
10. Aritomi H, Yamasaki Y, Yamada K, Honda H and Koshi M. Development of sustained release formulation of chlorpheniramine maleate using powder coated microsponges prepared by dry impact blending method. Journal of Pharmaceutical Sciences and Technology 1996; 56(1): 49-56.
11. Parthiban KG. Manivannan R. Krishnarajan D, Chandra S, Nidhin Raj. Microsp sponge role in novel drug delivery system. International journal of pharmaceutical research and development 2011; 3(4): 117-125.
12. Viral Shaha et al. Microsp sponge drug delivery system: A review Int. J. Res. Pharm. Sci 2010; 1:212-218
13. Swati Kale Valmik*1 Shalini R1 . Kanchan M2 .Ashwini C3 , Eknath P4, microsp sponge: comprehensive review of application, IJPBS, Volume 3, Issue 1, jan-mar |2013|214-226
14. Niyaz BB and Koti RV, Formulation and in-vitro evaluation of etodolac entrapped in microsp sponge based drug delivery system. Int J Pharma, 1(2), 2011, 73-80. © 2020 IJRAR January 2020, Volume 7, Issue 1 www.ijrar.org (E-ISSN 2348-1269, P- ISSN 2349-5138) IJRAR19K7826 International Journal of Research and Analytical Reviews (IJRAR) www.ijrar.org 972
15. Santanu Kaity, Sabyasachi Maiti, Ashoke Kumar Ghosh, Subham Banerjee. Microsp sponge: A novel strategy for drug delivery system. J. Adv. Pharma. Tech. Res, 1(3), 2010, 283-290.
16. Panwar AS, Yadav CS, Yadav P, Darwhekar GN, Jain DK, Panwar MS, Agrawal A. Microsp sponge a novel carrier for cosmetics. JGPT, 3(7), 2011, 15-24.
17. Vikrant K, Nikam, RT Dolas, Somwanshi SB, Gaware VM, Kotade KB, Dhamak KB, Khadse AN and Kashid VA. Microparticles: a novel approach to enhance the drug delivery - a review. IJPRD, 3(8), 2011, 170- 183.
18. Brunton LL, Lazo JS, Parker KL. Goodman and Gilman's „The Pharmacological Basis of Therapeutics“. 11th Edition. 2006, 1021
19. John I D' Souza and Harinath N. Topical anti-inflammatory gels of fluocinolone acetonide entrapped in eudragit based microsp sponge delivery system. Research J Pharm and Tech, 1(4), 2008, 502.
20. Comoglu T, Gonul N, Baykara T, Preparation and in vitro evaluation of modified release ketoprofen microsponges, II, Farmaco, 58, 2003, 101-106.
21. Jain N, Sharma PK, Arunabha Banik, Recent advances on microsp sponge delivery system, International Journal of Pharmaceutical Sciences Review and Research, Volume 8, Issue 2, May – June 2011.
22. Mahajan Anirudh G, Jagtap Leena S , Chaudhary Atul L, Swami Sima P, Mali Prabha R. Formulation and evaluation of microsp sponge drug delivery system using indomethacin, International research journal of pharmacy, I ISSN 2230-8407
23. Meenakshi Bhatia1 · Megha Saini. Formulation and evaluation of curcumin microsponges for oral and topical drug delivery, Bio Material Research 2018
24. Patel EK and Oswal RJ. Nanosp sponge and micro sponges: A novel drug delivery system. Int J Res in Pharm and Chem, 2(2), 2012, 237-244.
25. Saurabh Kumar, Tyagi LK, and Dashrath Singh. Microsp sponge delivery system (MDS): A unique technology for delivery of active ingredients. IJPSR, 2(12), 2011, 3069-3080.
26. Emanuele AD, Dinarvand R. Preparation, Characterization and Drug Release from Thermo responsive Microspheres. Int J Pharma 1995:237-42.

27. Joshna Booravilli, Janki devi sirisolla, Shivani Saluru. Formulation & evaluation of ketoconazole microsponges topical gel: International Journal of Research in Pharmaceutical Science. 2022 13(4) : 382-391

