ABSTRACT
The Microsponges Drug Delivery System are extremely small, inert, indestructible clusters of even tinier spherical particles of microscopic size patented polymeric delivery systems consisting of porous microspheres that can entrap a wide range of active ingredients such as emollients, fragrances, essential oils, sunscreens, and anti-infective, antifungal, and anti-inflammatory agents and are very well tolerated, and highly efficacious, novel products that do not pass through the skin, capable of holding four times their weight in skin secretions and can absorb skin secretions. Each microsphere consists of a myriad of interconnecting voids within a non-collapsible structure with a large porous surface, like a true sponge. Depending upon the degree of smoothness or after feel required for the end formula, the size of the microsponges can be varied usually from 5-300µm in diameter. Although the microsponges size may vary, a typical 25µm sphere can have up to 250000 pores and an internal pore structure equivalent to 10ft in length providing a total pore volume of about 1mVg. This results in a large reservoir within each microsponge which can be loaded with up to its own weight in active agent. For topical delivery of drugs, microsponge delivery system was originally developed and can also be used for controlled oral delivery of drugs using water soluble and bioerodible polymers. It holds a promising future in various pharmaceutical applications in the coming years like enhanced product performance and elegance, extended release, reduced irritation, improved thermal, physical, and chemical stability of product.

KEYWORDS: Microsponges, Microsponge Drug Delivery System, Delivery System.

INTRODUCTION
The original patents of the microsponge technology were assigned to Advanced Polymer Systems, Inc. and was developed by Won in 1987. This Company developed a large number of variations of the technique and applied those to cosmetic as well as OTC and prescription pharmaceutical products. At the present time, this interesting technology has been licensed to Cardinal Health, Inc., for use in topical products.

A Microsponge Drug Delivery System (MDDS) consisting of porous microspheres particles consisting of a myriad of interconnecting voids within non-collapsible structures with a large porous surface that can entrap wide range of actives (cosmetics, over-the-counter (OTC) skin care, sunscreens and prescription products) and then release them onto the skin over a time and
in response to trigger, highly cross-linked, porous, polymeric microspheres polymeric system (10-25 µ). A typical 25µm sphere can have up to 250000 pores and an internal pore structure equivalent to 10ft in length providing a total pore volume of about 1ml/g. Microsponge do not pass through the skin (capable of holding four times their weight in skin secretions). Rather, they collect in the tiny nooks and crannies of skin and slowly release the entrapped drug, as the skin needs it. The microsponge system can prevent excessive accumulation of ingredients within the epidermis and the dermis. These products contain relatively high concentration of active ingredients and are typically presented to the consumer in conventional forms like creams, gels or lotions. Microsponges are polymeric delivery systems consisting of porous microspheres that can entrap a wide range of active ingredients such as emollients, fragrances, essential oils, sunscreens, and anti-infective, anti-fungal, and anti-inflammatory agents.

The MDDS has advantages over other technologies like microencapsulation and liposomes. The release rate of actives cannot be controlled by microcapsules. Once the wall is ruptured the actives contained within microcapsules will be released. Lower payload, difficult formulation, limited chemical stability and microbial instability are suffered by liposomes.

Effective Merits of Microsponge Drug Delivery System:

- Stability of Microsponge formulations ranges from pH 1 to 11.
- Microsponge formulations are stable at the temperature up to 130°C.
- Microsponge formulations are compatible with most vehicles and ingredients.
- Average pore size of microsponge formulations is 0.25 µm where bacteria cannot penetrate and are self-sterilizing.
- Microsponge formulations have higher payload (50 to 60%), still free flowing and can be cost effective.
- Microcapsules cannot usually control the release rate of actives but MDDS usually control the release rate.
- Liposome suffers from lower pay load, difficult formulation, limited chemical stability and microbial instability and have wide range of chemical stability and easy to formulation.
- Microsponges are microscopic spheres capable of absorbing skin secretions, therefore reducing oiliness and shine from the skin.

Important applications of Microsponge

Microsponges are porous, polymeric microspheres that are used mostly for topical and recently for oral administration. It offers the formulator a range of alternatives to develop drug and cosmetic products.
Microsponges are designed to deliver a pharmaceutical active ingredient efficiently at minimum dose and also to enhance stability, reduce side effects and modify drug release. A Microsponge Drug Delivery System can entrap wide range of drugs and then release them onto the skin over a time and also in response to other stimuli including rubbing, moisture, pH, friction, or ambient skin temperature. It is a unique technology for the controlled release of topical agents and consists of nano or micro porous beads loaded with active agents and also use for oral delivery of drugs using bioerodible polymers, especially for colon specific delivery and controlled release drug delivery system.

The MDDS offers the potential to hold active ingredients in a protected environment and provide controlled delivery of oral medication to the lower gastrointestinal (GI) tract, where it will be released upon exposure to specific enzymes in the colon. Bioerodible systems based on new polymers for the delivery of small and large molecule drugs, including proteins and peptides, can also be developed which, if successful open up new fields of opportunity in systemic drug delivery arenas.

**Preparation of Microsponges**

Liquid or soluble drug to be entrapped in microsponges, it should be miscible with monomer, should be water immiscible, inert to monomer and stable in presence of polymerization catalyst. Microsponges are prepared by several methods utilizing emulsion systems as well as by suspension polymerization in a liquid - liquid system. The emulsion solvent diffusion method (ESD) is most common emulsion system used oil in-water (o/w), by which microsponges being produced.

Drug loading in microsponges can take place in two ways one step process or by two-step process which are based on physico-chemical properties of drug to be loaded. If the drug is typically an inert non-polar material, will create the porous structure it is called porogen. Porogen drug, which does not affect and activated by polymerization also stable to free radicals is entrapped with one-step process. Such Porogen drugs or pore forming agent can be entrapped while polymerization takes place by one-step process. When the drug is sensitive to the polymerization conditions, polymerization is performed using substitute porogen and such a process takes place by two-step process.

1. **Liquid-liquid suspension polymerization**

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 rate for given time period. Monomer or combinations of monomers are selected and polymerization begins to form chain monomers as a result of cross linking ladders are formed between chains of monomer. Monomer ladder are folded to form spherical particles i.e. agglomeration of microspheres, which give rise to formation of bunches of microspheres\(^7\).

Some time inert liquid immiscible with water but completely miscible with monomer is used during the polymerization to form the pore network. After the polymerization the liquid is removed leaving the porous microspheres i.e. Microsponges, solvent may be used for faster and efficient incorporation of the drug substances. The microsponges act as carriers for topical drug delivery of variety of functional substances, e.g. Anti acne, anti inflammatory, anti purities, anti fungal, rubefacients, etc.

2. **Quasi-emulsion solvent diffusion**

Microsponges are prepared with the help of ESD method. The organic internal phase containing drug and ethyl cellulose in dichloromethane which contained PVA as emulsifying agent gradually added into external phase. The mixture is stirred at 1,000-2,000 rpm for 3 hrs at room temperature to remove dichloromethane from the reaction. The formed microsponges are washed with distilled water, and dried at room temperature. Microsponges are weight and production yield (PY) is determined.

**Evaluation Methodology of Microsponge\(^8\)**

- Determination of particle size
- Surface topography and Morphology of microsponges
- Determination of production yield and loading efficiency
- True density determination
- Characterization of pore structure
- Compatibility studies
- Polymer/ Monomer composition

**CONCLUSION**

Microsponge Delivery System is a unique technology for the controlled release of topical agents and consists of micro porous beads loaded with active agent and used for oral as well as biopharmaceutical drug delivery. It can entrap wide range of actives and then release them onto the skin over a time and in response to trigger. A Microsponge Drug Delivery System can release
it’s active ingredients on a time mode and also in response to other stimuli. Thus, it is a very emerging field which is needed to be explored and microspponge has got a lot of potential.

REFERENCES


For Correspondence
Akshat Sharma
Email: akshat_ocp2006@yahoo.co.in