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Review Article

A Microsponge-Based Drug Delivery System For The Treatment Of Fungal Infection

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ABSTRACT

The microsponge delivery system is a highly interconnected permeable polymeric microsphere system made up of permeable microspheres that have the ability to absorb and deliver substances into the skin over an extended period of time. This system offers improved resistance, broader discharge with less disturbance, and improved physical, chemical, and warm steadiness. In this review, various strategies for designing microsponge drug delivery systems are examined. The main goal of any prescription transport structure is to accomplish the necessary collection of the medication in blood or tissue, which is therapeutically incredible and non-noxious for a somewhat long period of time. Different benefits are also offered, demonstrating the importance of this medication delivery strategy over alternative medication delivery systems. A increasing amount of delivery system innovations are being synchronized to improve the treatment's affordability and suitability. Microsponge innovation is acknowledged to help reduce incidental effects, further develop strength, expand style, and improve plan adaptability. It also offers entanglement of fixing. Additionally, numerous tests have confirmed that microsponge systems are not irritating, harmful, mutagenic, or allergenic. The innovation of microsponge delivery is currently being used in sunscreen, over-the-counter, healthy skin, and beauty care products.

INTRODUCTION

In recent periods, the research topography has shifted toward the innovative drug delivery technologies are being developed with high remedial exertion and case acceptance as aims. The field of drug delivery operations is becoming extensively demanding and is rapidly evolving1 .The healthcare system would profit greatly from a drug delivery mechanism that could directly manage the release rate as well as deliver drugs to

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particular bodily parts 2. Drug delivery systems are decreasingly being used to improve the energy and cost- value of drug treatment. Peptides, proteins, and DNA- based therapies are deficient when delivered by traditional means 3. External medications work on the skin's outermost layers in their conventional forms. generally, similar treatments release their active factors as soon as they're applied, performing in a thin layer of largely concentrated active substances that are quickly absorbed. likewise, there are other issues with topical drug operation, similar as greasiness, stickiness related to ointments, and much more, constantly resulting in a lack of patient adherence. Traditional dermatological medications frequently include numerous active ingredients that have a brief duration of effect. That may lead to a phase of overmedication for a shorter amount of time, followed by lengthy treatment with medicine 4 .Numerous drug classes evolve daily as drug delivery technology advances. A novel medication delivery system with predefined, determined rates at the distinct desired location of action should be designed to succeed against any disease. Drug Delivery Systems could modify the release rate or deliver medications to particular body regions, enhancing therapeutic effectiveness, the value of cost, and patient acceptance. A pharmaceutical company has a tremendous problem controlling the quantity at which APIs are released to such a particular region in the body. The invention of a microsponge medication delivery device mitigated the existing challenges. Microsponge technologies enable a uniform and long-lasting release, decreasing irritation while maintaining efficacy 5. Microsponge is polymeric delivery system composed of porous microspheres. They are tiny sponge like spherical particles with a large porous surface. It is a novel technique of drug delivery mainly for control release and target specific drug delivery system. Currently a lot of evaluation in delivery systems are being used to optimize the drug efficacy and cost-effectiveness of the drug, Microsponge delivery system (MDS) has been successively addressed for the controlled release of drugs onto the outer layer of skin (epidermis). Drug loaded microsponge consist of microporous beads, typically 10-25 μm in diameter that possess a versatility to entrap wide range of active agents (medicine or therapeutic active agents). Microsponge Systems are based on microscopic, polymer-based microspheres that can suspend or entrap a wide variety of substance or material. Microsponge technology entrap drug substance and reduces harmful effects, improved stability, increased smoothness, and enhanced formulation flexibility. A numerous studies have proved that microsponge system are nonirritating, no allergenic in nature. This method is also being used now days in cosmetics skin care, sunscreens or clinical care. One of the best feature is it is self-sterilizing.it also useful in oral drug delivery, bone and tissue engineering. The unique properties of MDS made it ideal carrier of various drugs with shorter half-lives and drugs which are affected from first pass metabolism. Main objective of microsponge is to minimizes or reduces drug dose and also minimizes side effects of drug and enhance the stability. Now-a-days microsponge are one of the most popular because of their use of controlled release and targeted drug delivery system. Microsponges has ability to retain in skin cell or tissue and prevent the dose dumping in blood circulation, which may cause side effects. Microsponge system offers entrapment of active ingredients, improved stability, reduced side-effects, enhanced preparation and formulation flexibility. According to different studies microsponges system are nonallergic, nonirritating, non-mutagenic and non-toxic in nature. This method now involves in cosmetics, skin care, sunscreens and clinical prescription products.

History of Microsponges

The micro sponge technology was developed by Won in 1987 and the original patents were assigned to Advanced Polymer Systems, Inc. (Redwood City, California, US). This Company developed a large number of variations of the procedures and those are applied to the cosmetic as well as over-the-counter (OTC) and prescription pharmaceutical products. At the current time, this interesting technology has been licensed to Cardinal Health, Inc., for use in topical products to facilitate the controlled release of active drug into the skin in order to reduce systemic exposure and minimize local cutaneous reactions to active drugs 6.

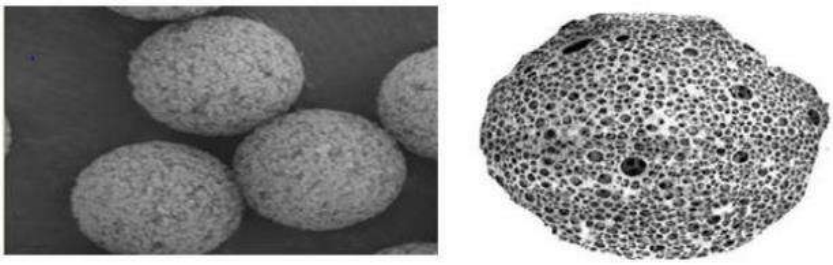

Figure 1: Structure of microsponge

Potential features or characteristic of microsponge drug delivery systems:

- Microsponges show adequate soundness over pH going from 1 to 11 and at high temperatures (up to130°C).
- Microsponges show great similarity with different vehicles and ingredients.
- Microsponges have high entanglement productivity up to 50 to 60%.
- Microsponges are described by free streaming properties.
- The normal pore size of microsponges is little (0.25 μm) in a method for forestalling the entrance of microbes, in this way they do not need cleansing or expansion of preservatives.
- Microsponges are non-allergenic, non-bothering, nonmutagenic and non-toxic.
- Microsponges can ingest oil up to multiple times theirweight without drying.3

Characteristics of actives moieties that is entrapped into microsponges 7,8:

- Active ingredients that are entrapped in microsponge can be incorporated into many products such as creams, gels, powders, lotions and soaps.
- Certain considerations are taken into account while, formulating the vehicle in order to achieve desired product characteristics.
- It should be either fully miscible in monomer as well as capable of being made miscible by addition of small amount of a water immiscible solvent.
- It should be inert to monomers and should not increase the viscosity of the mixture during formulation.
- It should be water immiscible or nearly only slightly soluble.
- It should not collapse spherical structure of the microsponges.
- It should be stable in contact with polymerization catalyst and also in conditions of polymerization.
- The solubility of actives in the vehicle must be limited.
- Payload and polymer design of the microsponges for the active must be optimized for required release rate for given period of time.

Advantages of microsponge drug delivery system 9 :

- Enhances product performance.
- Decreases irritation and increases patient compliance.
- Gives elegance to product. It can be incorporated into different formulation.
- Has good thermal, physical and chemical stability.
- Non-irritant, non-mutagenic, non-toxic and nonallergenic.
- Converts fluids into powders to improve material handling.
- Improves drug bioavailability.
- Improves treatment efficiency.
- In contrast to other technologies like liposome and microencapsulation, MDS has a wide range of chemical stability, higher payload and are easy to formulate.
- Improved formulation flexibility.
- Flexibility to develop novel product forms.

Composition of microsponge:

Different polymers utilized in manufacture of microsponges for effective application bring about arrangement of a microsponge 'confine'. According to distributed writing, polymers investigated up to this point incorporate polymethacrylates or Eudragit© polymers (EudragitRS100, Eudragit RSPO, Eudragit S100), polylactide-co-glycoliccorrosive, polylactic corrosive, polydivinyl benzene, polyhydroxy butyrate and ethyl cellulose. Eudragit RS100 is the most generally concentrated on polymer, inferable from its adaptable nature. The wide scope of Eudragit polymers, contrasting in control, dissolvability further more water penetrability, considers exceptionally custom-made delivery qualities in this framework, working with a wide scope of choices to accomplish the ideal presentation. Polymers having a place with polymethacrylate classification are Food and Drug Organization (FDA) supported, protected, non-harmful and monetary excipients, generally utilized in the drug business. The adaptability to join diverse polymethacrylate polymers offers a superior control on drug discharge conduct, particularly because of medication methacrylate–polymer cooperation. Being an establishment material for microsponges, ethyl cellulose is too utilized for designing of microsponges because of its nonirritating, nontoxic and no allergenic nature. Another polymer, polydivinyl benzene, has been accounted for the creating of permeable microspheres by fluid suspension polymerization method. Albeit, a few polymers have been investigated of late, yet just couple of studies has been accounted for with biodegradable polymers. They can be potential excipients for the advancement of microsponge transporters for drug focusing on. Henceforth, there is a solid need to investigate biodegradable polymers for this conveyance framework. Adjacent to this, the decision of polymer should consider skin aggravation and dermal poisonousness potential. This being a main pressing issue in dermatological definitions, has been considered by a few gathering of analysts working in the area of microsponge based conveyance frameworks10.

Drug release mechanisms 11

The mentioned programmable parameters can be effectively manipulated to design Microsponge delivery system for the release of functional substance over a period of time in response to one or more external stimuli.

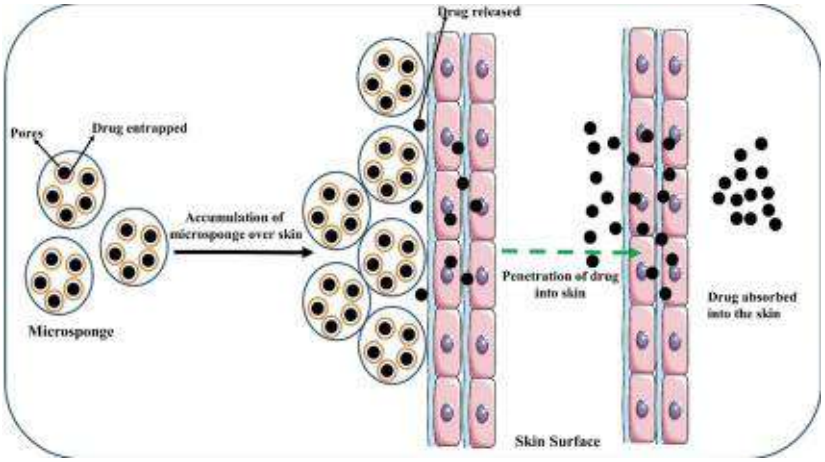

Figure 2: Mechanisms of drug release from topical microsponges

The release mechanism of this system is mainly:-

Sustained or Timed Release :

In the development of a sustained release Microsponge, different physical and chemical parameters of the entrapped active substance such as volatility, viscosity and solubility will be studied while in case of polymeric microsponge pore diameter, volume, and resiliency of the polymeric microsponge are evaluated to give necessary sustained release effects.

Release on Command:

Microsponges can be designed to release the given amounts of active ingredients over time in response to one or more external triggers.

Pressure Release:

Microsponge system releases fluid or active ingredient when it is pressed or squeezed, thereby replenishing the level of entrapped active ingredient onto the skin. The amount released may also depend upon the release of the sponge and the resiliency of the Microsponges.

Temperature Release:

The release of active ingredients from microsponges can be activated by temperature. At room temperature, few entrapped active ingredients can be too viscous to flow suddenly from microsponges onto the skin. With increase in skin temperature, flow rate is also increased and therefore release is also enhanced.

pH Triggering : The pH-based release of the active can be achieved by modifying the coating on the microsponge. This has many applications in drug delivery.

Solubility:

Microsponges loaded with water miscible ingredients like antiseptics and antiperspirants will release the ingredient in the presence of water. The release can also be activated by diffusion but taking into consideration, the partition coefficient of the ingredient between the microsponges and the external system.

Fungal infection:

More often than not, the human species live in serene concurrence with the microorganisms that encompass them and just when the guard framework is harmed or the grouping of microbes comes to an especially high thickness, a disease might arise. Most contaminations pass by unnoticed yet now and then the tainting specialists do get a reaction of the body, which prompts clinically show signs and indications, a condition known as irresistible illness. Microbes, infections, parasites, growths, prions, worms, helminths have all been implicated in irresistible sicknesses, of which those brought about by normal infections are the most successive, and, until years and years prior, those by microorganisms the most dreaded. As procedures to control bacterial contaminations in patients improved, organisms turned into the

most unsafe microorganisms. Yeasts and forms currently rank among the10 most habitually disengaged microbes among patients in Intensive Care Units. Roughly 7% of all febrile scenes that happen during neutropenia can be credited certainly to intrusive contagious contaminations. Candida has turned into the fourth driving circulatory system detach in medical clinics in the USA, outperforming numerous generally infamous bacterial microbes. Since the eighties an expanded rate of intrusive contagious contaminations in patients who are not in an end phase of their fundamental sickness was observed. Moreover, because of the universal low dissection rate their rate is likely misjudged on the grounds that signs and manifestations are rarely trademark, which makes that numerous obtrusive parasitic diseases are not recognized while the patient is alive.12

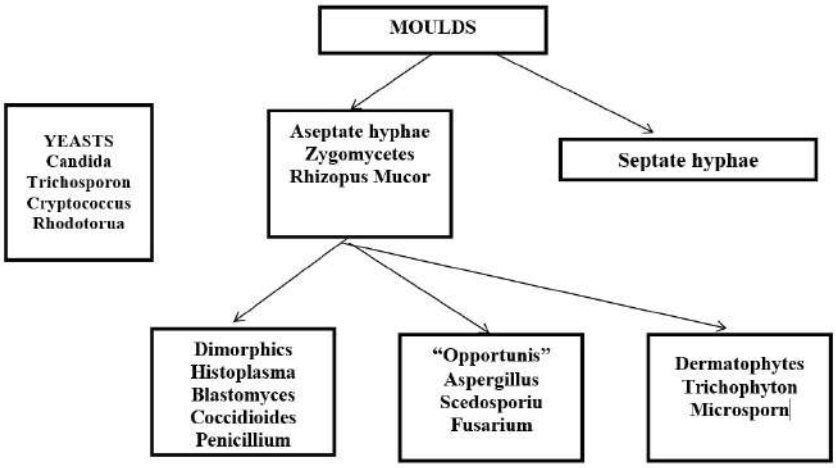

Figure 3: Classification of fungus

Mycology:

Parasites are momentous organic entities and they establish a different realm for reasons for characterization. Parasites are eukaryotes; they have a film encompassing their core, their cells are a lot bigger than microorganisms and theirsub-atomic cycles intently look like those of plants and creatures. In any case, in contrast to mammalian cells, growths quite often have an unbending cell divider made out of chitin items that encompass their plasma layer (see figure no.4). A growth is a vegetative organic entity and is most certainly not a plant either on the grounds that parasites don't blend chlorophyll. It is non-motile living thing and its fundamental primary unit comprises of either a chain of round and hollow cells (hyphae) or a unicellular structure, or both. The most widely recognized species like Aspergillus and Candida are tracked down wherever on the planet. Gardens, jungle gyms, houses, lodgings, emergency clinics and surprisingly the skin and mucous layers have been recognized as wellsprings of organisms that caused hazardous diseases.

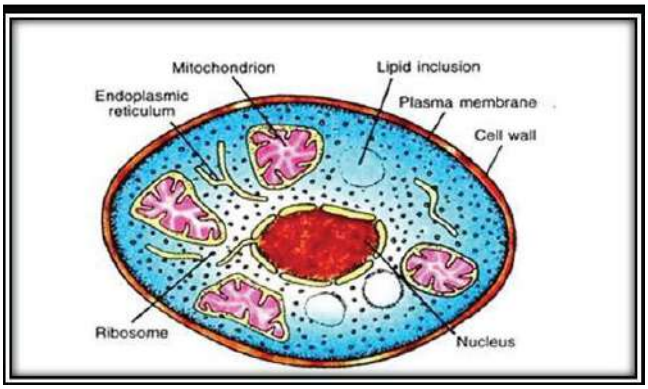

Figure 4: The fungus.

Pathophysiology of fungal infections:

A couple of the organisms pathogenic for people are adequately harmful to contaminate a sound host. Most are relatively innocuous except if they experience an immune-compromised patient, in whom a debilitated guard framework grants them to attack the body. Under typical conditions, the

unblemished epithelial surfaces of the gastrointestinal lot will forbid attack by miniature living beings and the mucociliary hindrance of the respiratory parcel forestalls goal of parasitic cells and spores, while, interestingly, dead or harmed tissue might transform into a favorable place for contamination. Therefore intrusive contagious diseases must be positioned among the commonly crafty contaminations.13

Method of preparation of microsponges:14,15

The microsponge is formulated by two ways the one step process or by two step processes discussed in liquid-liquid suspension polymerization and Quasi emulsion solvent diffusion method which are based on the physiochemical properties of the drug.

1. Liquid-liquid suspension polymerization:

In this method the monomers are firstly dissolved along with active ingredients in a suitable solvent solution of monomer and are then dispersed in the aqueous phase with agitation. Aqueous phase typically consists of addictives such as surfactants and dispersants (suspending agent) etc inorder to facilitate the formation of suspension. Once the suspension is established with distinct droplets of the preferred size then polymerization is initiated by the addition of catalyst or by increasing temperature as well as irradiation.50 The polymerization method leads to the development of a reservoir type of system that opens at the surface through pores. During the polymerization, an inert liquid immiscible with water however completely miscible with monomer is used to form the pore network in some case. Once the polymerization process is complete the liquid is removed leaving the microsponges which is permeate within preformed microsponges then, incorporated the variety of active substances like antifungal, anti acne, anti inflammatory etc and act as a topical carriers. The various steps involved in the preparation of microsponges are summarized as follows

- Step1: Selection of monomers and combination of monomers
- Step2: Formation of chain monomers as polymerization starts
- Step3: Formation of ladders as a result of cross-linking between chain monomers.
- Step4: Folding of monomer ladder to form spherical particles.
- Step5: Agglomeration of microsphere leads to the production of bunches of microspheres.
- Step6. Binding of bunches to produce microsponges.

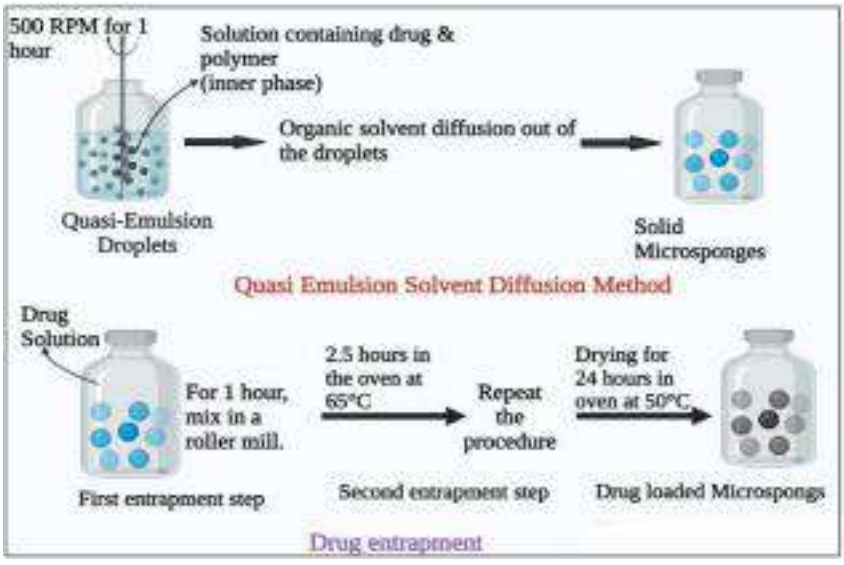

Figure 5: Method of Preparation of Microsponges by Quasi Emulsion Solvent Diffusion Method

Mechanism of action:

For the active material to emerge from the matrix of the Microsponge particle at a pre determined rate, a number of parameters can be modified taking into consideration the physical-chemical characteristics of the active agent and the environment. The vehicle in which the polymer resides plays an important role in the release rate of active agent from the system. Initially, there is equilibrium between the concentration of active agent in the polymer and in the vehicle as the skin depletes the concentration of the active agent from the vehicle, the MDS releases more active agent in response to the demand caused by the shift in the equilibrium. A continuous and steady release of active agent onto the skin is accomplished with such a system. In addition, as opposed to conventional topical formulations, the MDS can act as a reservoir and continue to release active agent to the skin even after the vehicle has been absorbed by the skin or has dried out.

Evaluation of microsponge:

The microsponge are evaluated by the following parameters

- Particle size and size distribution analysis
- Drug content
- Entrapment efficiency
- Angle of repose
- Compressibility index
- Hausner's ratio
- Determination of density: Bulk density &Tapped density
- Production yield:

Microsponge production yield was determined by formula mentioned below:

Production yield (%) = Practical mass of microsponges x 100 Theoretical mass (polymer + drug)

- **Scanning electron microscopy:**

The surface topography and morphology of prepared microsponge were examined with a scanning electron microscope. For this method using double adhesive tape, samples were mounted on a metal stub and coating with platinum/ palladium alloy under vacuum was done.

- **Particle size analysis:**

The mean particle size microsponges was determined using an optical microscope. The microscope was fitted with a stagemicrometer to calibrate the eyepiece micrometer. The particle diameter of around 30 particles was measured in a field.The average particle size was determined using the following formula:

$$\mathbf{Dmean = \sum nd / \sum n}$$

Where, n = number of microsponges observed and d =mean size range.

- **Infrared spectroscopy:**

Infrared spectroscopy was determined by Fourier transform Infrared Spectrophotometer with KBr pellet method.

- **Differential scanning calorimetry (DSC):**

To find the interaction between the drug and excipients thermal analysis is an important evaluation technique. The interaction can be identified by with any changes in the thermogram. The thermogram of drug was obtained using the DSC instrument. The powder sample of microsponge was kept in the aluminum pan and heated at a constant rate of 100 C/ min over a temperature range of 300 C to 3000 C under a nitrogen atmosphere of the flow rate of 20 ml/min16.

Evaluation of microsponge loaded gel formation:

The microsponge prepared gel was evaluated by different parameters such as pH, appearance, viscosity, spreadability, drug content and drug release, in vitro antifungal activity andstability studies.

- **Appearance:**

The microsponge prepared gel bases were inspected visually for clarity, color and presence

of any particles. Microsponge loaded carbopol gel shows transparent gel.

- **PH:**

Microsponge loaded gel formulation was dissolved in water and the pH was determined with the help of digital PH meter. All the gels are tested for pH three times and average of three determinations was calculated.

- **Spreadability:**

The microsponge gels are keeping between two horizontal glass slides of standard dimension. 100g weight was placed on the top of the two slides so that the formulation gets uniformly spread. The weight was removed and excess formulation was scraped out.

$$S = m \times L/T$$

Where,

m = weight kept on the upper slide

l = length of glass slide

t = time taken in second

- **Viscosity:**

Viscosity of microsponge loaded gel formulation was determined using Brookfield viscometer with spindle no 6 at 10 rpm at 37 0 C temperature.

- **Drug content:**

1 gram of gel formulation containing drug equivalent to 10 mg of drug was extracted and the volume was made up to 50 ml with ethanol. The resulting solution was filtered. Suitable dilutions of the filtrate were prepared with filtrated phosphate buffer pH 5.5 and absorbance was measured at specific wavelength using UV spectrophotometer.17,18

- **In vitro release of microsponges gel:**

The in vitro release microsponges gel was performed using a modified Franz diffusion cell with Spectra Pore dialysis membrane molecular weight cut off with an effective diffusion area of 3 cm. The release medium was 100 ml acetate buffer pH 4 containing 1% SLS. One gram gel or powder was placed on the dialysis membrane which was previously soaked overnight in the release medium. The receptor medium was stirred at 50 rpm and maintained at 34°C. Aliquots of 3 ml were withdrawn at predetermined intervals over 6 h and replaced by an equal volume of the fresh medium to maintain sink conditions. The samples were analyzed spectrophotometrically at 270 nm for content and drug flux through the membrane was calculated. In order to investigate the mechanism of drug release form microsponge, zero order, first order, Higuchi, and Korsmeyer-Peppas models were applied on the release profile of microsponges gel.19

Application of Micro-Sponges:

Microsponges have a wide range of uses. It is usually used topically, although it has been recently taken orally. It can be utilised as an excipient, according to several patents, because of its loading capacity and long-term releasing ability 20.

- **In oral Drug Delivery:**

Microsponges are used to enhance the solubility rates of weakly hydrophilic drugs in oral administration by trapping them in the pores of the micro-sponge system. Controlled oral administration of Ketoprofen and Flurbiprofen was developed using the ERS 100 polymer by quasi-emulsion solvent diffusion technique 21-24

- **Topical drug delivery:**

It has been discovered that topical delivery of benzoyl peroxide with a controlled release reduces side effects while increasing percutaneous absorption. Before being evaluated for its ability to treat irritated or sensitive skin and to combat bacteria, microsponges were developed and distributed on a gel basis. A topical delivery approach with less irritancy was successfully developed 25-26 .

- **Micro-Sponge for Bone and Tissue Engineering Bone- Substitute:**

Collagen microsponges were delivered as well as displayed angiogenesis action locally in such a dose-dependent manner once the collagen was

integrated into the mice sub-cutis. These findings highlight type I collagen's therapeutic potential and primary function as a BFGF (Basic Fibroblast Growth Factor) reservoir 27.

- **Cardiovascular Engineering Using Microsponge Technology:**

In cardiovascular surgery, collagen microsponge has the potential to use as a bioengineered material to enhance in situ cellularization and autologous tissue regeneration. As a biodegradable substrate, poly (lactic-co-glycolic acid) was mixed with collagen microsponge to deliver a vascular patch material.28

- **Reconstruction of the Vascular Wall Using Microsponge Technology**

A biodegradable polymeric scaffold of polyglycolic acid knitted mesh was coupled with a collagen-Microsponge. Moreover, it strengthened the exterior contains polylactic acid weaved to create the tissue-engineered patch. Tissue-engineered patches were grafted without pre-cellularization. No thrombosis formed in some of the animals. The grafts exhibited excellent in situ cellularization using hematoxylin/eosin. Two months after implantation, a polymerase chain reaction analysis of the cell population revealed many endothelial and smooth muscle cells 29-30.

- **Anti-Ulcer**

In peptic ulcers, microsponges can be used to targeting to enteric cells with anti-ulcer medicines. High medicine loading capacity made them easy to include in a traditional capsular system to treat stomach ulcers. Such delivery methods have potential advantages in terms of better therapeutic response and consistent rate of release.

- **Antifungal Drugs**

Many antifungal drugs are available in gels or creams, which promote faster absorption. Microsponges preloaded gels shown controlled and sustained release, as well as a high drug yield and loading capacity. Topical fluconazole treatment for severe life-threatening skin fungal infections is an effective medication.

- **Anticancer Drugs**

Modern cancer treatments include radiation, chemotherapy, and surgery, but they all have serious physiological and psychological side effects that primarily damage the patient's healthy cells. They can treat cancers of the stomach, pancreas, colorectal, and breast. Delivery of anticancer medications is a quickly developing field, with various delivery methods created for different types of cancer.

- **Anti-Arthritis**

Medications Microsponges of antipyretic drug diclofenac sodium were developed for the treatment of rheumatoid arthritis.

- **Antiepileptic Drugs**

An anti-epileptic medication called carbamazepine (CBZ) is used to treat bipolar disorder, epilepsy, and trigeminal neuralgia. CBZ microsponges were made using a quasi-emulsion solvent diffusion method (PVA) with varying EC and PVA compositions. XRD, DSC, and FTIR were utilized to examine the microsponges31.

Table 1:- Application of microsponges with advantages

Sr. no.	Application	Advantage
1.	**Anti-acne**: Eg: Benzoyl peroxide	Maintained efficacy with decreased skin irritation and sensitization.
2.	**Anti-inflammatory**: Eg. Hydrocortisone	Long lasting activity with reduction of skin allergic response and dermatoses.

3.	**Sunscreens:**	Long lasting product efficacy with improved protection against sunburns and sun related injuries even at elevated concentration and with reduced irritancy and sensitization.
4.	**Anti-fungals:**	Sustained release of actives ingredient.
5.	**Anti-dandruffs**:Eg. Zinc pyrithione, selenium sulphide.	Reduced unpleasant odour with lowered irritation with extended safety and efficacy.
6.	**Antipruritics:**	Extended and improved activity.
7.	**Skin depigmenting**: Eg: Hydroquinone	Improved stabilization against oxidation with improved efficacy and aesthetic agents appeal.
8.	**Rubefacients:**	Prolonged activity with reduced irritancy greasiness and odour.

Recent advances in microsponge drug delivery 32

Advanced formulations are being developed by several researchers and pharmaceutical businesses. Tey are as follows, with a higher level of stability than MDS.

- **Nanosponges**

It has been demonstrated that these are very good carriers for moving gas. Cytotoxic increases the efficacy of the drug by enabling it to target cancer cells when combined with nanosponges as carrier systems. βCD nanosponges are created by using biphenyl carbonate to crosslink the βCD molecule. Both hydrophilic and hydrophobic medications can be made with them. This advanced method was used to analyze medications such as flurbiprofen, dexamethasone, itraconazole, and others.

- **Nanoferrosponges**

Self- promising nanoferrosponges flaunt enhanced penetration towards a specific position as result of external glamorous response that permits carriers to reach deeper towel before glamorous material is excluded,thereby forming a pervious system.

- **Porous microbeads**

Better microsphere properties led to the creation of porous microbeads. Solid porous microbeads are created through the application of cross-linking and polymerization processes. A cross-linker, an interior aqueous phase, and an exterior oil phase make up the monomer used in the high internal phase emulsion technique. Drug delivery methods that are topical, buccal, and oral use microbeads. This approach's enhanced RNA stability and successful siRNA encapsulation provide a novel therapeutic route for siRNA administration.

Table 2: List of marketed products using microsponge drug delivery system

Product name	Pharmaceutical uses	Manufacturer
Aramis fragrance's	It soothes and cools the skin surface	Aramis inc.
Carac cream, 0.5%	Actinic keratoses	Dermik laboratories Inc.,
Benzyl peroxide	Anti-acne	
Dermalogica oil control lotion	Skin protectant	John & ginger dematol

Epiquin micro	Hyper pigmentation	Skinmedica inc.
Glycolic acid moisturizer w/spf 15	Anti-wrinkles, soothing	Amcol health & beauty salon
Line eliminator dual retinol facial treatment	Anti-wrinkle	Avon
Lactrex™12% moisturizing cream	Moisturizer	Sdr pharmaceuticals, inc
Murad moisturing cream	Moisturizer	Murad inc.
Micro peel plus/acne peel	Anti-wrinkles, softer skin and smoother skin surface	Biomedic
Neutrogena oil free acne face wash	Anti-acne	Jhonson and jhonson
Neobenz®micro, neo®microsd neobenz®microwash	Absorb natural skin oils and act as antibacterial	Intendis inc. Morristown
Oil free matte block spf 20	Sunscreen	Dermalogica
Retin a micro	Acne vulgaris	Ortho-mcneil pharmaceutical, inc
Retinol 15-night cream	Anti-wrinkles	Sothys
Retinol cream	Helps maintain healthy skin	Biomedic
Salicylic peel 20 and 30	Excellent exfoliation	Biophora
Sports cream rs and xs	Anti-inflammatory	Embil pharmaceutical co. Ltd.
Shine stopper oil control	Control oil, minimize pore appearance, smooth imperfection	Paula‟s choice skincare
Ultra guard	Protects baby`s skin	Scot paper company

FUTURE PROSPECTS OF MICROSPONGE AS DRUG DELIVERY SYSTEM:

Microsponge drug delivery system would soon offer promising opportunities in multiple pharmaceutical implementations as it has distinctive characteristics such as enhanced product quality and elegance, expanded release, enhanced drug release profile, decreased discomfort, enhanced physical, chemical, and thermal stability, making it easy to develop novel product form. It provides a wide range of formulating advantages. Liquids can be transformed into free flowing powders. Formulations can be developed with otherwise incompatible ingredients with prolonged stability without use of preservatives. Safety of the irritating and sensitizing drugs can be increased and programmed release can control the amount of drug release to the targeted site. The actual role in the future is the design of the delivery system for oral peptide distribution by variable polymer ratio. Newly developed classes of pharmaceuticals, biopharmaceuticals (peptides, proteins and DNAbased therapeutics) are fueling the rapid evolution of drug delivery technology. The use of bioerodible and biodegradable polymers for drug delivery enables it to deliver active content safely. Since these porous structures have additionally been researched for drug delivery through the pulmonary path, that demonstrates that these structures will demonstrate economical drug discharge even within the deficiency of the dissolved fluid; the colon being the associate economical destination location for drug discharge. These carriers additionally got to be established for different methods of drug administration such as parenteral and pulmonic pathways. These carrier systems have also found

their application in cosmetics because of their class. These developments enabled researchers to create varying use of them. These novelties within the formulation additionally open up new ways that of delivering drugs

CONCLUSION:

Microsponges have a discrete advantage over the existing conventional topical dosage forms for the treatment of dermatological diseases. A Microsponge Delivery System can entrap wide range of actives and then release them onto the skin over a time and in response to trigger. It is a unique technology for the controlled release of topical agents and consists of microporous beads loaded with active agent for topical and also use for oral as well as biopharmaceutical drug delivery. It provides a wide range of formulating advantages; Liquids can be transformed into free flowing powders. MDS is originally developed for topical delivery of drugs like anti-acne, anti-inflammatory, anti-fungal, anti-dandruffs, anti-pruritics, rubefacients etc. With extended stability and no need for preservatives, formulations containing incompatible ingredients can be created. The amount of medication released to the intended site can be controlled by programmed release, which also increases the safety of irritating and sensitizing drugs. As a result, future developments in controlled drug delivery systems will primarily utilize the microsponge drug delivery system as a key tool. Thus, microsponge has got a lot of prospective and is a very up-and-coming field which is needed to be explored.

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