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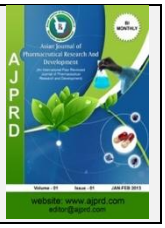

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Review Article

Emerging Role of Microsponges in the Treatment of Psoriasis: A Comprehensive Review

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A B S T R A C T

Psoriasis is a chronic autoimmune inflammatory skin disorder characterised by red, scaly, and itchy plaques, resulting from an accelerated turnover of skin cells due to an overactive immune response. Although various treatment options are available, ranging from topical agents to systemic therapies and biologics, they are often associated with limitations such as poor drug penetration, systemic side effects, and reduced patient adherence. Recent advances in drug delivery, particularly microsponge-based systems, offer a novel approach to overcoming these challenges. Microsponges enable controlled drug release, improved skin retention, and enhanced therapeutic efficacy. This review highlights the potential of microsponge technology in the management of psoriasis and discusses its advantages over conventional formulations.

Keywords: Psoriasis, autoimmune disorder, microsponge technology, targeted therapy, controlled release, topical drug delivery.

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INTRODUCTION

PSORIASIS

Psoriasis is a constant, autoimmune, and seditious complaint and is characterised by red, itchy plaques and macules, which appear as a result of increased proliferation and poor differentiation of keratinproducing epidermal cells. These pillars are frequently accompanied by Argentine scales [(1)]. The largely lit lesions appear as a result of imperfect signals produced by the vulnerable system to increase the mitosis rate of keratin-producing cells by tenfold [(2)]. This, in turn, leads to capital retention and deficient cornification of stratum corneum cells. This complaint sets in the early stages of life and sluggishly progresses for the entire continuance. Psoriasis is of different types depending on the affected areas [(3-5)]. According to reports, the frequency of psoriasis varies from 0.09 to 11.43 in colourful nations [(6)]. On average, 2- 5 per cent of people worldwide suffer from psoriasis [(7)]. Although it has spread worldwide, its prevalence varies by region and race. In general, the circumstance increases with latitude [(8)]. As a result, psoriasis is less common in Asian and African nations than in tropical nations like Europe and Australia [(9)]. According to recent exploration, the complaint's frequency has multiplied over the past many times [(10)].

Although there are numerous remedial options available moment to help reduce the complaints, suggestions and symptoms, a full cure is still a delicate undertaking. Some downsides of traditional drug delivery styles, similar to topical treatments, include high lozenge conditions, poor medicine penetration, and dropped patient compliance [(11)]. Conventional remedies are also limited by the toxicity of systemic and phototherapy. For this reason, it's pivotal to probe and develop innovative, safe, and effective delivery styles for the treatment of psoriasis [(12)].

Psoriasis generally affects the nails and skin. rotundity, psoriatic arthritis, metabolic pattern, diabetes, and cardiovascular complaint are comorbidities associated with T cell- intermediated responses that are constantly seen in cases with psoriasis [(13)]. As a result, another name for its T- T-T-cell intermediated autoimmune complaint. Excrescence necrosis factor (TNF α), interleukins (ILS), and interferon-γ (IFN-γ) are exemplifications of seditious cytokines that rise

modestly in the systemic circulation and primarily in the dermis. Vascular endothelial growth factor (VEGF) is produced by mast cells, keratinocytes, and macrophages as a result of elevated cytokines and other seditious intercessors. According to recent exploration, psoriasis is caused by 25 different inheritable variations. The vulnerable system getting activated is the cause of psoriasis, and the gene that causes it has been set up. By furnishing precise and effective treatments, this could progress in the treatment of psoriasis [14]. There are currently several distinct clinical phenotypes of psoriasis. Additionally, phenotypes are identified based on their anatomical locations. Table 1 presents a comprehensive list of the various forms of psoriasis that have been reported along with their key attributes.

Table 1: List of the Different Types of Psoriasis

Clinical Phenotype	Characteristics	Ref
Plaque psoriasis	It mostly occurs on the scalp, trunk, and outer legs.	15
Guttate psoriasis	It is characterised by small, red or scarlet, scaly lesions (papules) that may fall off.	16
Pustular psoriasis	Scales and sterile pustules spread over the legs and buttocks. Characterised by noninfected scales or pustules.	17
Erythrodermic psoriasis	Large areas of erythematous lesions were observed. Loss of the characteristics of plaques and papules.	18
Palmoplantar psoriasis	Appears as a yellow background surrounding erythema, sanitary, and affected palms and soles. This kind of psoriasis produces minor pustules that eventually turn brown and stick to the crust.	17
Flexural psoriasis	The features include bright red lesions that develop on skin folds such as the armpits, beneath the breasts, and the groin area. Scales are less likely to form because of the area's lower moisture content.	19
Nail psoriasis	Onycholysis, subungual hyperkeratosis, nail whitening, nail cracking, bleeding capillaries beneath the nail, and yellow-red discolouration are known as an oil spot or salmon spot.	18
Scalp psoriasis	The scalp is the area most affected by psoriasis. It usually occurs around the hair and makes life worse due to the appearance of the hair.	19
Genital psoriasis	Genital psoriasis can affect individuals of all ages, with one-third of psoriasis patients experiencing this type.	19

Signs and symptoms of psoriasis [20]

Depending on the type of psoriasis a person has, their signs and symptoms may change. The following are the top 5 signs of psoriasis:

1. Itchy, itchy skin that can break or bleed;
2. Rashes or patches of red, inflamed skin that are frequently coated in loose, silver-colored scales; in extreme cases, the plaques will expand and merge into one another, covering huge areas.
3. Tiny patches of bleeding when the skin is irritated.
4. Discolouration and pitting of the fingernails and toenails, as well as the possibility of the nails crumbling or coming loose from the nail bed.
5. The scalp has scaly plaques.

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Current Treatment Options

Many traditional methods, including topical, oral, biological, and parenteral medicines, can be used to treat psoriasis. Additionally, phototherapy has been utilised to alleviate symptoms.

TOPICAL THERAPY

Treatment of psoriasis is often associated with irritation and often provides poor clinical results. Specific treatments are considered the mainstay of treatment for mild to moderate psoriasisCosmetics may cause skin reactions such as itching and burning, which may lead to patient non-compliance [21]

Table 2: Marketed topical anti-psoriatic formulation

Marketed topical antipsoriatic formulation	Active ingredient
Dovonex	Calcipotrene (Vitamin D)
Temovate	Clobetasol
Aristocort	Triamcinolone
Synalar	Fluocinolone
Diprolene	Betamethasone
Psoriatec	Dithranol
Tazorac	Tazarotene
Oxsoralen	Methoxsalen
DHS tar	Coal tar

Oral therapy

Oral treatments used to treat psoriasis usually include medications that can be administered orally. Oral treatments have more side effects than topical treatments. Therefore, they cannot be used with chemical agents or as a treatment to reduce side effects or improve performance. Oral therapy is

often used when topical medications fail to improve symptoms. Common drugs used for oral treatment include:

Acitretin:

The acidic metabolite of the acitretin ester has been used for remedial purposes since the 1970s. . It is a retinoid that acts by interfering with the growth of keratinocytes [22]. It is derived from vitamin A and has no immunosuppressive properties.

Methotrexate:

It inhibits dihydrofolate reductase, an enzyme needed for the conversion of purines and pyrimidines in the creation of DNA. It's the most traditional and affordable drug for mild to moderate psoriasis. By converting to polyglutamic acid analogues and raising the amount of adenosine, an anti-inflammatory substance, it exhibits anti-inflammatory properties [23]. It enhances T cell apoptosis and decreases epithelial hypertrophy [24]. Additionally, it has anti-inflammatory and anti-inflammatory properties. To minimise adverse effects, it's generally advised to take folic acid concurrently. Hepatotoxicity may result from prolonged use. Salicylates and antibiotics are among the medications with which methotrexate interacts. Thus, use caution when taking this medication. **Cyclosporine**

Cyclosporine is a potent calcineurin inhibitor that has been used for many years to treat severe psoriasis [25]. This inhibitory effect reduces IL2 synthesis. Side effects include high blood pressure, nausea, headache, and increased sensitivity. It works very quickly. However, it is stated that the drug is safe during pregnancy.

Fumaric Acid Esters

Those had been first suggested for psoriasis treatment in 1959. It's a combination manufactured from dimethyl fumarate and monoethyl fumarate. those exert anti-inflammatory, antioxidative and antiproliferative consequences. It has been shown to have a very good protection and efficacy profile. but numerous gastrointestinal facet results are recognised to be associated with fumaric acid esters [26]. The leukocyte count is observed to decrease at some stage in treatment. The less common facet effects observed for the duration of the treatment encompass oedema of the lower extremities, headache, fatigue, and pruritus. Fumaric acid ester treatment is recommended in conjunction with the topical psoriasis treatment.

Phototherapy

By exposing the skin to UV rays, phototherapy can lessen the visibility of skin plaques and the itching that goes along with them. The therapeutically active range of these radiations is between 290 and 400 nm, while the other range is between 100 and 400 nm. Light treatment, however, helps manage the symptoms of the illness but does not treat it. It works by suppressing the skin's immune system, reducing uncontrollably rapid cell division, and changing the expression of certain cytokines [27]. Each person reacts to phototherapy in a different way. With three to five sessions per week and a two to three-month treatment duration overall, the therapy demands a significant time commitment. Patients receiving phototherapy run the risk of getting skin cancer. There are three types of phototherapies: UV-A, UV-B, and UVA1. Longer wavelengths make up UV-A, which can potentially reach deep layers of the skin. Psoralen, which increases the skin's receptivity to UVA treatment, is typically administered in conjunction with the UV-A treatment. Because UV-B has short wavelengths, it cannot reach deeper layers of the skin.

Advanced Drug Delivery Systems/Techniques for the Treatment of Psoriasis

Table 3: A Summary of Selected Advanced Delivery Systems for Psoriasis

Formulation	drug used	Result	Ref
Liposomes	Methotrexate	Liposomes coated with methotrexate could be applied topically as a less harmful formulation.	**28**
	Teritoin	Enhanced pharmacodynamic efficacy, biocompatibility, and skin penetration	**29**
Solid lipid nanoparticles	Clobetasol	The formulation exhibits enhanced skin penetration and extended drug release.	**30**
	Fluocinolone acetonide	There was a noticeable quantity of fa on the skin's epidermal layer.	**31**
Nanostructure lipid carrires	Curcumin	Increased moisture and curcumin accumulation in the skin have been reported.	**32**
	Pentoxifyllin e	Pentoxifylline-loaded nanostructured lipid carriers show potential as topical agents for psoriatic skin and can be formulated quickly without pretreatment.	**33**
Niosomes	Tazarotene	The formulation shows that there is a strong drug accumulation in the skin layers and is good for cosmetics.	**34**
Microsphere	Apremilast	Formula-showing gel microspheres are effective in treating psoriasis	**35**
Nanoemulsion	Methotrexate,	Good tissue and serum levels, high permeability and improved patient compliance.	**36**
Dendrimer	Dithranol	The formulation seems to prevent the auto-oxidation of the anti-psoriasis drug, circumventing traditional drug delivery limitations.	**37**
Gold nanoparticle	Methotrexate,	Increase efficiency and delivery to the dermis and epidermis layers	**38**
Polymeric nanoparticle	Dexamethason e	Increases drug concentration at the point of action and provides controlled release with higher efficiency	**39**

Phytopharmaceuticals In the Treatment of Psoriasis

Table 4: Phytopharmaceuticals in the treatment of psoriasis

Phytopharmaceutical	Mode of Action	Type of Study	Inference	Ref
Aloe vera	Regulates the immune system and reduces inflammation	*ex vivo* study, *in vivo* drug release study	It helps psoriatic wounds recover and lessens the appearance of lesions.	40
Neem	Anti-inflammatory, antimicrobial and	*In vivo* study in human volunteers	There is a noticeable decline in the psoriatic severity score.	41
Olive oil	Antioxidant, anti-inflammatory	*In vivo* study in human volunteers	It reduces cutaneous proliferation and changes.	42
Turmeric	Inhibits phosphorylase kinase and decreases the activity of proinflammatory cytokines		prevents psoriatic lesions from being harmed by free radicals.	43
Gallic acid	Inhibits KRT16 and KRT17, antioxidant, anti-proliferative and antiinflammatory	Cell line study	reduces psoriatic skin consistence and removes scales and mars.	44
Vitamin D	Strengthens the immune system, prevent new cell growth	*In vivo* study in human volunteers	Remove the wound	45

Microsponges Role in Psorasis

By reducing drug side effects and extending contact time, a microsponge-based topical drug delivery method can increase patient compliance (a crucial aspect of cosmetic treatment in the competitive market). Because of their colloidal qualities, microsponges are well-known and show promise for use in dermatology. Carriers are appealing for ordinary medical applications because of their good qualities, which include increased drug utilisation and stability, as well as the capacity to lessen mutagenicity, allergies, and skin irritation. Skin targeting, controlled release, and less percutaneous penetration are further characteristics that make them the preferred treatment for skin conditions. Extending the active ingredient's duration of contact with the skin or epidermis while simultaneously blocking its penetration into the body is essential for a positive local effect. Because microsponges can prolong contact durations due to their unique size (5–300µm), microcarriers are the preferred carriers for local medication administration. Microstructures are less permeable, nevertheless, when applied directly to the skin. In order to improve treatment, these medications are incorporated into cosmetics such as gels, latex, and creams [46].

Microsponges' Delivery System

The delivery system for microsponges consists of a patented polymeric sponge with globular, permeable patches and a high medicine content system. [47] They consist of a number of connected vacuums contained within a large permeable structure that is non-collapsible and permits the controlled release of active constituents. A typical 25 m sphere can have up to pores and an internal severance structure that is an average of 10 ft in length. Its periphery varies from 5 to 300 m, and its severance volumes range from 0.1 to 0.3 cm^3/ g, giving it a total severance volume of roughly 1 ml/g for wide medicine retention [48]. They offer a wide range of advantages and can be incorporated into traditional lozenge forms such as creams, poultices, gels, ointments, tablets, and makeups, creating expression flexibility [49].

History of Microsponge

Advanced Polymer Systems, Inc. entered the first patents for the microsponge technology in 1987. This company developed multiple performances of the technology and applied it to traditional drugs, cosmetics, and other products. As of right now, Cardinal Health, Inc. is certified to use this fascinating technology in topical specifics. Applying microsponges to the skin causes their bioactive element to release gradually over a designated amount of time in response to various instigations, including temperature, ph, and rubbing [50].

Potential Features or Characteristics of Microsponge Drug Delivery Systems [51,52]

- Microsponges exhibit respectable stability at high temperatures (up to 130°C) and pH values between 1 and 11.
- It works well with a range of ingredients and vehicles.
- The entrapment effectiveness of microsponges can reach 50–60%.

Advantages Microsponge Delivery System [51, 52]

Microsponges have superior thermal, physical, and chemical stability;

- They can absorb oil up to six times their weight;
- And they offer continuous action for up to 12 hours, or extended release.
- They are non-toxic, non-irritating, non-mutagenic, and non-allergic.
- Immiscible items can be incorporated thanks to MDS.
- Their formulation flexibility is superior.
- MDS can increase the same medications.
- It can also increase therapy effectiveness.

Characteristics Of Materials That Are Entrapped In Microsponges [51-53]

- It should be fully miscible with the monomer and should be made miscible by adding a small quantity of water immiscible detergent.

- It should be inert to monomers and shouldn't increase the density of the admixture during expression.
- It shouldn't disrupt the globular structure of the microsponges.

Microsponges Advantages over Conventional Formulations

Conventional topical medications are solely intended to address localised issues such as cuts, injuries, facial bleeding, etc. These products have high API attention due to their rapid-fire skin penetration and ineffective results. Microsponges, as opposed to conventional phrasings, bear a lower quantum of API to ply the needed remedial exertion because they avoid an inordinate accumulation of factors in the epidermis and dermis. likewise, Microsponges ameliorate patient safety and compliance by significantly reducing negative side effects caused by API accumulation on the skin's face. Due to unbridled API evaporation in numerous topical drugs and implicit incompatibility, a fresh vehicle is needed in expression [54].

Applications of Microsponges (55 -60)

Microsponges have several uses and are commonly used as a medication delivery mechanism in the pharmaceutical industry due to their unique properties. Microsponges have been shown to be an effective tool for controlled medication release, targeted therapy, and drug delivery in a variety of conditions and illnesses.

Sustained and Controlled Drug Delivery: One drug delivery method that can be used to both sustain and control the release of drugs is the use of microsponges. Active pharmaceutical ingredients (APIS) can be added to them. Because of the porous nature of microsponges, the medication can be released gradually over time, producing a longer-lasting impact and reducing the need for frequent dosing (55).

Topical transport systems: Creams, gels, and lotions can all benefit from the use of microsponges to enhance the delivery of APIS to the skin. They can limit drug release, improve skin penetration, and stop drug degradation [56].

Taste-Masking Agents: Microsponges can be used to cover up the taste of medications that have an unpleasant or bitter flavour. To enhance flavour and patient compliance, the medication can be placed into microsponges and subsequently covered with a substance that masks taste [57].

Oral Drug Delivery: Microsponges can be used in oral drug delivery to improve the solubility, stability, and bioavailability of medications. They can improve patient compliance and assist in stopping the medication from breaking down in the digestive system by reducing the frequency of delivery[57].

Targeted Drug Delivery: By modifying microsponges with ligands or antibodies to target specific cells or tissues, systemic toxicity can be reduced and targeted drug delivery made possible [56].

Dermatological issues: Microsponges can be used to treat a variety of dermatological issues, including rosacea, psoriasis, and acne. They can be filled with strong pharmacological ingredients and applied to topical formulations to improve the efficiency and duration of drug delivery to the skin [58].

Infections: Microsponges can be loaded with antibiotics to treat infections caused by bacteria, fungi, and contagions. They offer bettered lozenge control and extended release, thereby reducing the frequency of administration and enhancing patient compliance [59].

Rheumatoid Arthritis: Microsponges can deliver anti-inflammatory drugs to joints for arthritis treatment. Controlled release of these drugs from microsponges reduces pain and inflammation, thereby improving patient outcomes [60].

Alzheimer's disease: Alzheimer's complaint medicines that treat symptoms of Alzheimer's complaint can be delivered to the brain via microsponges. The porosity of microsponges can control medicine release in the brain, reduce side effects and ameliorate patient issues [61].

Ocular drug delivery: Microsponges have become increasingly popular because they can increase drug bioavailability, reduce toxicity, and increase drug retention time. First, microsponges can prolong drug retention in the eye, promote drug absorption, and reduce delivery frequency. Second, they eliminate the need for antibiotics by preventing drug odour. Third, microsponges can increase the safety of ocular drug delivery by reducing the risk of side effects and toxicity. They can be incorporated into different types of eye creams, including ointments, gels, and suspensions [62].

Polymers For Preparation of Microsponges.[63-71].

Microsponges are polymeric materials widely used in medicine and cosmetics to control the release of active ingredients. Some of the most common polymers used to prepare microsponges are as shown as follows

Polyvinyl alcohol (PVA): PVA-based microsponges exhibit excellent swelling capacity and sustained drug release [63].

Polyacrylate is frequently used as a microsponge due to its excellent water immersion capacity and biocompatibility. Microsponges are made using colourful polyacrylates, including poly (ethyl acrylate), poly (methyl acrylate), and poly (butyl acrylate) [64].

Chitosan: Chitosan is a biopolymer made from chitin and is frequently used in pharmaceutical applications due to its biocompatibility and biodegradability. It has been reported that chitosan-based microsponges can provide sustained drug release and can be used in the treatment of various diseases, including cancer and diabetes [65].

Polycaprolactone (PCL): The biodegradable polymer PCL has been used to create microsponges due to its excellent properties and biocompatibility. PCL-based microsponges have been reported to exhibit drugreleasing behaviour and can be used in the treatment of various diseases such as osteomyelitis [66].

Polyethene glycol: Microsponges made from polyethene glycol (cut) have been developed as promising agents for medicine delivery. Polycaprolactone is a biocompatible and biodegradable polymer that can be produced using a variety of ways, including solvent evaporation and conflation

polymerisation and can be cross-linked using colorfulcross-linkers similar as hexamethylene diisocyanate [67].

Polystyrene (PS): PS microsponges have been considerably studied in medication for ornamental operations. PS is a hydrophobic polymer that can be crosslinked using colourful crosslinking agents (e.g. divinylbenzene) and can be produced using a variety of different styles, including conflation polymerisation and suspension polymerisation [68].

Polyacrylamide (PAAm): Microsponges produced from PAAm have been developed as medicine delivery systems. PAAm is a water-soluble polymer that can be synthesised via conflation polymerisation and rear phase suspension polymerisation using a variety of reagents, including N, N' N' methylenebisacrylamide. [69].

Eudragit: The family of synthetic polymers known as Eudragit are constantly used in medicine formulations due to their high biocompatibility, bioadhesion, and controlled medicine release parcels. Microsponges made from Eudragit have been extensively studied as medicine delivery systems. Different types of Eudragit polymers, such as Eudragit RS100, Eudragit S100, Eudragit L100, Eudragit RSPO and Eudragit RL100, have been used to make microsponges [70].

System of Medication of Microsponges

Liquid-liquid suspension polymerisation [71-73]

Porous microsphere-based microsponges were prepared by suspension polymerisation. In this polymerisation process, immiscible monomers are first dissolved in a suitable solvent together with the active ingredient and then dispersed in an aqueous phase containing a surfactant or extraction agent used to form the suspension. The polymerisation is then activated by heating or electricity, or by adding a catalyst. The polymerisation process continues until a reservoir-type system with a spherical structure is formed. After the polymerisation process, the solvent is removed, leaving the microsponge.

Quasi-emulsion solvent diffusion [74-76]

Using a two semi-emulsion detergent prolixity fashion, pervious microspheres (microsponges) were created. A polymer (like Eudragit) dissolved in a solvent (like ethanol) makes up the inner phase of this model. Triethyl citrate (TEC) and other polymers are added to help with plasticity after the medication is gradually melted by ultrasonics at 35°C. After that, the inner phase is added to the outer phase, which contains distilled water and polyvinyl alcohol, and it is constantly stirred for two to three hours. The microsponge is subsequently separated from the mixture by filtering it. Afterwards, the microsponges were gutted and dried for ten to twelve hours at 40 °C in a roaster.

Oil painting in oil painting conflation detergent prolixity

Mixes are formed using this fashion because the internal phase contains an immiscible liquid. Dichloromethane is used as an unpredictable detergent in utmost phrasings. The polymer used is polylactide glycolic acid (span 85). To make microsponges, the internal phase is sluggishly introduced into the dissipation medium with constant stirring [77].

Addition of porogen

For this purpose, porogens such as hydrogen peroxide or sodium bicarbonate form the internal phase. By dispersing the polymer solution, a uniformly dispersed system containing the porogen is formed in the polymer solution, which is then dispersed in the aqueous phase containing PVA. When hydrogen peroxide is added, connected pores ranging in size from 5 to 20 μm are formed (78).

Lyophilisation

By rapidly removing the solvent, the microspheres are converted into porous microspheres during the process. This is done using chitosan hydrochloride. After incubation in this result, the microspheres were snap-dried. Due to the rapid removal of the solvent, the product may break and/or shrink [79].

Vibrating orifice aerosol generator method

The conflation of lipid bilayer mesoporous silica patches is done using only wobbling perforation aerosol creator technology. Tetraethyl orthosilicate, ethanol, water and dilute hydrochloric acid were refluxed to form a result that formed the core patches. After dilution with a detergent containing surfactant, the medicine begins to form monodisperse droplets. Liposomes contain useful microspheres. There are several ways to produce microsponges (80). utmost microsponges are produced by semi-emulsion detergent prolixity, which has the least negative impact on the finished product compared to other styles.

Each of the below styles has its unique scheme.

Multiple-emulsion (W/O/W emulsion) Solvent Diffusion

Utilising traditional design technology, biodegradable porous microspheres are produced. This involves combining an organic polymer solution with an internal aqueous phase that contains emulsifiers like span, polyethene, and stearylamine. To create a second emulsion, this non-emulsifier is then re-dispersed in an external aqueous phase that contains PVA. Proteins and other heat-resistant compounds can also be captured with it. Additionally, xanthan gum is described by some writers as an emulsifier that stabilises the interior without creating an emulsion [81].

Effect of Formulation Variable on Microsponges [82]

The effect of the composition of the internal and external phases:

The larger the apparent viscosity difference between the dispersed phase and the continuous phase, the larger the average particle size of the micro sponge. Due to the higher viscosity of the internal phase, the spheres of the resulting emulsion can be broken into small particles, and when the dispersed substance becomes more viscous, large droplets will be seen to be poured into the continuous phase (external phase). The average particle size increases. Only 3 to 5 ml of the internal phase is needed to produce the best microsponges. When the internal level is increased from 5 ml to 15 ml, the micro sponge results and the drug content decrease. This is because the attention of the internal phase is advanced and the attention of the medicine is lower.

Effect of drug-polymer ratio:

One factor influenced by the drug's conversion to polymer is particle size. The size of microsponges grew along with the rise in medicine consumption. The loading capacity is unaffected when the drugpolymer ratio is altered while the polymer concentration remains constant; nevertheless, the results vary greatly from the smallest to the largest.

Effect of stirring rate:

Small microsponges will be formed as the competition progresses. The efficiency decreased as the mixing speed increased, but the chemical content increased, indicating that the chemical content decreased as the mixing speed increased. This is due to external turbulence causing the polymer to stick to the paddle and reducing output.

EVALUATION OF MICROSPONGES [83-89]

Determination of Particle Size:

By processing small particles during the polymerisation process, a free-flowing powder with good texture can be produced. Laser diffraction or other suitable techniques can be used to determine the size of the load and to remove the microsponges. All nutrients (d 50) values allow expression. About dimensions. To investigate the effect of particle size on drug release, the percentage of drug release versus time from microsponges of different particle sizes will be plotted. At the end of the cosmetics, it is better to use products with a size between 10 and 25 m because products larger than 30 m can beautify the face [83].

Morphology and surface morphology of microsponges

The set microsponges were carpeted with gold and pre-treated at room temperature and argon atmosphere, and the morphology and face morphology were analysed to gain the face morphology of the microsponges. The superstructure of the crushed microsponge patches can also be seen in the SEM images [84].

Determination of loading efficiency and yield of microsponges

The loading efficiency (%) of microsponges can be determined by the following formula: by accurately calculating the initial weight and final weight of the raw material according to the obtained microsponges. the weight, yield of the product can be determined [84].

Determining true density

Using a superpycnometer and helium gas, determine the true density of the product and benzyl per oxide (BPO) from the average of several measurements.

Polymer/Monomer Combination

The properties of the active species and the medium in which they are dispersed will influence the choice of monomer. Polymers can be designed with different charges or degrees of hydrophobicity or lipophilicity to facilitate the release of active agents. Various monomer combinations can be evaluated for drug interactions by examining drug release profiles.

Compatibility Studies

The compatibility of chemicals with reactive additives can be studied using thin layer chromatography (TLC) and Fourier transform infrared spectroscopy (FT-IR). Powder X-ray diffraction (XRD) and differential scanning colourimetry can be used to study the effect of polymerisation on crystallinity (DSC). For DSC, samples can be accurately measured in aluminium pans, sealed, and heated in nitrogen gas at a rate of 150/min over the temperature range of 25- 4300 °C. (85) The properties of the final species captured and the medium in which they are dispersed will affect the choice of monomer. Polymers can be designed with different charges or degrees of hydrophobicity or lipophilicity to facilitate the release of active agents. Various monomer combinations can be evaluated for drug interactions by examining drug release profiles.

Drug release

Disintegration of microsponges can be controlled using a special basket made of 5 µm stainless steel mesh and a USP XXIII dissolution apparatus. The rotation speed is 150 rpm. The solubility of the active substance is taken into account when selecting the dissolution medium to provide the binding. The patterns in the separation medium can be analysed at different times using appropriate techniques [86].

Elasticity

The elasticity of the microsponges (viscoelastic properties) can be adjusted to form beads that are easier to process or harder, depending on the requirements of the final formulation. Greater binding will reduce the release rate of the drug. The elasticity of the microsponges was investigated and modified, and considered where necessary to obtain optimal dissolution of the drug in this region. Depending on the changes in binding over time [87].

Pore Structure Characterisation

Several porosity measurements have been studied for microsponges, including total pore surface area, intrusive extrusion isotherm, pore size distribution, mean pore diameter, pore form and morphology, volume and visibility, and true density. Pore volume and diameter influence the concentration and duration of action of active ingredients, and pore size also influences the transfer of active ingredients from microsponges to the worms [88].

Determination of pore diameter

Determination of pore diameter using the B.E.T. method. Nitrogen multipoint analysis and pore volume measurement using mercury porosimetry, which has traditionally been used to measure and report pore size [89].

Some Marketed Microsponge Formulations

Table 5: Some Marketed Microsponge Formulations

Sr no	Brand name	Drug	MSD	Formulation	Application	Ref
1	Zordem E	Oxiconazole	Topical drug delivery	Gel	Antifungal	90
2	Realdom- 500	Naproxen	Colon specific	tablet	Anti inflammatory	91
3	Nizral	Ketoconazole	Topical drug delivery	Gel	Antifungal	92
4	Prediom	Prednisolone	Colon targeted drug delivery system	Tablet	Prediom	93
5	Lulifin Lupizol	Luliconazole	Topical drug delivery system	Gel	Antifungal	94
6	Tazorac	Tazarotene	Topical drug delivery	gel	Psoriasis	95
7	Oricon	Econazole nitrate	Topical drug delivery	Hydrogel	Antifungal	96
8	Wellcam 15	Meloxicam	Transdermal drug delivery system	Gel	Oesteoarthritis	97
9	Curcumin Boost	Curcumin	Colon targeted	Tablet	Ulcerative colitis	98
10	Diflucan	Fluconazole	Targeted drug delivery	Capsule	Antifungal	99

CONCLUSION:

Psoriasis continues to pose a therapeutic challenge due to its chronic progression and multifactorial pathophysiology. While existing treatments provide symptomatic relief, they are often hindered by limited skin penetration, systemic side effects, and issues related to patient compliance. Novel drug delivery systems—particularly microsponge-based formulations—offer a promising alternative by enabling targeted, sustained, and localised drug release. These advanced systems not only enhance therapeutic efficacy but also minimise adverse reactions. Future advancements in formulation science and personalised treatment strategies hold the potential to significantly improve the quality of life for patients with psoriasis, establishing microsponges as a valuable platform in dermatological therapy.

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