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Comparative Assessment of the Antibacterial Potential of Curcumin and Tridax Procumbens Microsponge-Based Gel Formulations

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Abstract

The aim of the present study was to formulate, evaluate, and compare the antibacterial activities of topical gel formulations containing *Tridax procumbens* and curcumin-loaded microsponges. The microsponges were prepared using the quasi-emulsion solvent diffusion method, with ethyl cellulose as the polymer and polyvinyl alcohol as the stabilizer. The prepared microsponges were subsequently incorporated into a Carbopol-based gel to develop microsponge-loaded topical formulations. The formulations were evaluated for physicochemical parameters, including production yield, compatibility, surface morphology using scanning electron microscopy (SEM), pH, viscosity, spreadability, washability, and stability. SEM analysis revealed that the microsponges were spherical, porous, and uniformly distributed, indicating their potential suitability for controlled drug release. The pH values of the formulated gels were within the acceptable range for topical application, suggesting good compatibility with the skin. Antibacterial activity was evaluated using agar well diffusion method. Both Tridax procumbens and curcumin microsponge-based gels demonstrated notable antibacterial activity, with the curcumin-loaded microsponge gel exhibiting comparatively larger zones of inhibition against certain bacterial strains. The findings suggest that microsponge-based gel formulations may offer a promising approach to controlled topical drug delivery, with potential benefits in drug stability and patient compliance, along with improved antibacterial performance compared with conventional gel formulations. Further studies are required to establish their clinical efficacy and confirm their advantages over conventional topical preparations.

Keywords: *Tridax procumbens*, Curcumin, Microsponges, Topical Gel Formulation, Antibacterial Activity, Quasi-Emulsion Solvent Diffusion.

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INTRODUCTION

A drug delivery system (DDS) is a formulation or device designed to introduce a therapeutic agent into the body by controlling the rate, timing, and location of drug release, thereby improving its efficacy and safety. Following administration of the therapeutic product, its active ingredients must be released and transported across biological membranes to the site of action. The DDS serves as an interface between the patient and the medication. The critical factor may lie in the drug delivery mechanism or in the composition of the formulation intended for therapeutic use [1].

A medication's effectiveness may be affected by how it is absorbed in the body. Certain drugs have an optimal concentration range that provides maximum therapeutic benefit; concentrations above or below this range may be toxic or ineffective. By delivering a therapeutic dose to the appropriate site in the body, a novel drug delivery system aims to rapidly achieve and maintain the ideal drug concentration. The ideal drug delivery system should help optimize drug therapy by delivering the right amount of drug at the right time to the intended site.

Therefore, during treatment, a drug delivery system (DDS) should release a drug at a rate appropriate

to the body's therapeutic requirements. The microsponge drug delivery system (MDS), developed in 1987, is a patented polymeric delivery system consisting of porous microspheres. These spherical particles resemble tiny sponges and contain numerous interconnected pores within a non-collapsible structure. Their highly porous architecture provides a large surface area and facilitates the controlled release of active ingredients. The pore size typically ranges from 5 to 300µm, with a pore volume of approximately 1 mL/g, providing substantial capacity for drug loading. The active ingredients entrapped within the microsponge system is released in a controlled manner [2, 3].

Microsponge drug delivery systems consist of relatively small, inert, spherical particles designed primarily for topical application. These particles generally remain on the skin surface and are intended to deliver active pharmaceutical ingredients locally while minimizing systemic absorption. Microsponge-based formulations can help regulate drug release, improve drug stability, and potentially reduce local irritation and other adverse effects. These systems are generally composed of polymeric matrices capable of adsorbing or entrapping various active substances. Microsponge particles can be incorporated into topical formulations such as gels, creams, liquids, and powders. Drug release may be influenced by factors such as friction, pressure, temperature, and the properties of the formulation. Certain microsponge systems can also be designed to respond to water or moisture, facilitating the release of the encapsulated active ingredient [4–6].

Tridax procumbens Linn., a member of the family Asteraceae, is a medicinal plant traditionally used to manage various ailments in humans and animals. In Indian traditional medicine, different extracts of T. procumbens have been used for wound healing and the management of fungal infections, diarrhoea, and dysentery. The plant has also been investigated for its potential antioxidant, antimicrobial, anti-inflammatory, anticoagulant, and immunomodulatory properties. Its leaf extracts have been used in folk medicine for certain infectious skin conditions. T. procumbens is also commonly known as coat buttons; however, the name Bhringraj is more commonly associated with Eclipta prostrata (syn. Eclipta alba) in Ayurvedic medicine. The plant contains various phytoconstituents, including phenolic compounds, terpenoids, essential oils, and other secondary metabolites. Phenolic compounds and related phytochemicals may contribute to plant defense mechanisms against microorganisms, insects, and herbivores. These constituents have attracted scientific interest because of their potential biological activities and possible applications in topical formulations [7].

METHODS AND MATERIALS

Collection of Materials

The *Tridax Procumbens* extract was prepared in the VMCP campus, and Curcumin drug purchase was carried out for M S SCIENTIFIC CHEMICALS & INSTRUMENTS all other excipients and equipment required for formulation and evaluation are available in Vinayaka Mission College of Pharmacy (VMCP), and the SEM analysis and anti-bacterial activity are also available in VMCP.

Preformulation Studies

A suitable dosage form is required to achieve the desired therapeutic efficacy. In the present study, preformulation studies included solubility analysis and the assessment of physical characteristics, such as color and odor.

METHODOLOGY

The quasi-emulsion solvent diffusion method involves two main steps and can be used to prepare microsponges with controlled drug-release characteristics. This method involves the use of different amounts of polymer (See Table 1 for Quantitative composition of ingredients) and consists of two phases: the internal phase and the external phase. The internal phase consists of the drug and polymer dissolved in a suitable solvent, while the external phase consists of polyvinyl alcohol (PVA) dissolved in distilled water. The internal phase is gradually added to the external phase under continuous stirring. The resulting mixture is subjected to ultrasonication to facilitate the dispersion of the internal phase in the external aqueous phase containing PVA. The mixture is then stirred for approximately one hour and filtered to collect the solid microsponges. The collected microsponges are dried in an oven at 35°C-40 °C for 12 hours before further use [8–10].

Table 1: Quantitative Composition of Ingredients

Sl. No	Ingredients	Curcumin (g)	*Tridax Procumbens* (g)
1	Microsponge loaded drug	**0.2**	**0.2**
2	Carbopol -934	0.3	0.3
3	Ethanol	10	10
4	Methyl paraben	0.15	0.15
5	Propyl paraben	0.05	0.05
6	Propylene glycol	12	12
7	Tri-ethanol amine	2	2
8	Distilled water	QS.	QS.

Preparation Of *Tridax Procumbens* and Curcumin Microsponges Internal phase

Polymer (ethyl cellulose) is dissolved in solvent (dichloromethane), with the aid of a magnetic stirrer (10 minutes), and the drug is added into the solution using a continuous stirrer (10-15 minutes).

External phase

Polyvinyl alcohol is added to the warm and continuous stirrer till it dissolves completely.

Both phases

External phases are kept under constant stirring with the aid of the lab stirrer at 35°C for 2 hours (500 rpm). The internal phases are added to the external phases with the aid of drop-wise Filter the sample after 2 hours and dry the sample in the hot air oven (12 hours, 40°).

Preparation of Microsponge-Loaded Gel

Preparation of Carbopol gel

Weighed the Carbopol 934 with the help digital weigh machine take the distilled water or De-mineralized in a beaker and soaked for 2hrs mix the carbopol and distilled water with the help of a lab stirrer (complete soluble carbopol) check pH with a pH meter and adjust the pH with the help of Triethanolamine amine(mixed thoroughly) gel foam is formed Incorporate both formulations solid Microsponges are incorporated with gel foam PH adjuster, permeation enhancer, and preservatives are added to the formulation to increase the stability.

Evaluation of Microsponges

Product Yield and SEM

The Product yield was determined by direct calculation of original weight of raw accoutrements and final weight of microsponges attained [11]. To characterize the morphology of the microsponge and its surface, microsponge formulations were imaged by scanning electron microscope (SEM) [12].

Product Yield = Practical mass of Microsponges/ Theoretical mass (Polymer medicine)

Evaluation of Microsponge-Loaded Gel: Physical Appearance, Visual Inspection, Odor, and Consistency

The microsponge-loaded gel formulations containing Tridax procumbens and curcumin were evaluated for their physical appearance, clarity, color, odor, consistency, thickness, smoothness, grittiness, stickiness, and spreadability. Visual inspection was performed to assess the uniformity of the formulations and the presence of any visible particulate matter or aggregates. The odor of each formulation was assessed by noting its characteristic smell and intensity. The consistency and thickness were evaluated by gently handling the gel and observing its texture and ease of application. Smoothness and grittiness were assessed to determine whether the formulations contained any perceptible coarse particles. Spreadability was evaluated by observing how easily the gel spread across the skin surface. These assessments helped characterize the physical quality and suitability of the microsponge-loaded gels for topical application.

pH Determination

The pH of the set gel was determined using a pH cadence (standardized using buffer, pH 7, prior to use) by inserting the tip of the electrode into the gel and, after 2 minutes, recording the reading. The pH value of the expression was measured in triplicate and the average determined [13].

Density Determination

The density of microsponge gel was Determined using a Brookfield viscometer (LVDV- E Mode) using a spindle at different rpm at room Temperature. It was carried out with 10 g of sample. The base position of the instrument was set up using a position index. The spindle used was gutted and attached to the instrument. Also, the spindle was rotated in the Gel until a constant reading was displayed in the viscometer. The system was repeated in colorful RPMs, 5,10,15 Eventually the density of the gel expression was calculated at colorful shear rates [14].

Evaluation of Spreadability

The spreadability of Tridax Procumbens loaded microsponge gel was measured by spreading 0.5 g of the gel on a circle of 2 cm peripheries-marked on a glass plate, and also an alternate glass plate was Employed. 50g of weight was permitted to rest on the upper glass for 5 min. The periphery of the circle after Spreading the gel was determined. $S = M \times L / T$. [15]

Washability

The microsponges gel expression was applied to the skin face. Waited for some time and placed under valve water for 10 twinkles. After the Specified time, skin is visually examined, and assures that any of the product remains on the skin.

Antibacterial Exertion of Medicine Loaded Microsponge.

Well-diffusion method

Muller- Hinton agar media was used then, and we used the Band plate system to insulate the strain. Emasculate the Inoculating circle by heating it in a flame until red hot, also allow it to cool. Dip the cooled, castrated circle into the Microbial Sample. Gently band the circle back and forth across a small section of the agar face. The antimicrobial study Was done by the good prolixity system. Also, by using a Borer, make wells on the Petri plate. Also add the set Micro sponger gel into the well. Incubate all the petri dishes for 24 hours. A zone of inhibition was also Observed, which is suggested by the clear area around the well [16].

RESULTS AND DISCUSSION

The organoleptic properties of Tridax procumbens microsponge formulations were evaluated based on their color and odor. The T. procumbens microsponge formulation exhibited a light green color with a slightly sweet odor, whereas the curcumin formulation was yellow in color with a characteristic fragrant odor. Using a digital pH cadence, the set expression's pH was adjusted to 6.6, which was within the reasonable topical operation range of 4–7. The topical formulations need to have a neutral pH. The solubility of curcumin and T. procumbens in different solvents was assessed. The substances were found to be soluble in ethanol, dichloromethane, chloroform, acetone, and dimethyl sulfoxide, while their solubility in distilled water varied.

Chemical and physical compatibility studies indicated that the drug and excipients did not show any visible physical changes when blended and stored at room temperature under the tested conditions. The compatibility of the drug and excipients should be further confirmed using appropriate analytical techniques.

The percentage yield of the drug-loaded microsponges was calculated based on the practical mass of the recovered product relative to the theoretical mass of the drug and polymer used. A product yield of 71% was reported for the T. procumbens-loaded microsponges. The study also reported that 50% of the drug-loaded microsponge product was obtained for the curcumin formulation.

Morphology by SEM:

The face displays a micrograph of the face morphology of *Tridax Procumbens* microsponges and curcumin made using a quasi-conflation fashion See Figure 1. They are often pearly and globular. The chargers are not visible in the SEM pictures of curcumin and *Tridax Procumbens* Microsponges.

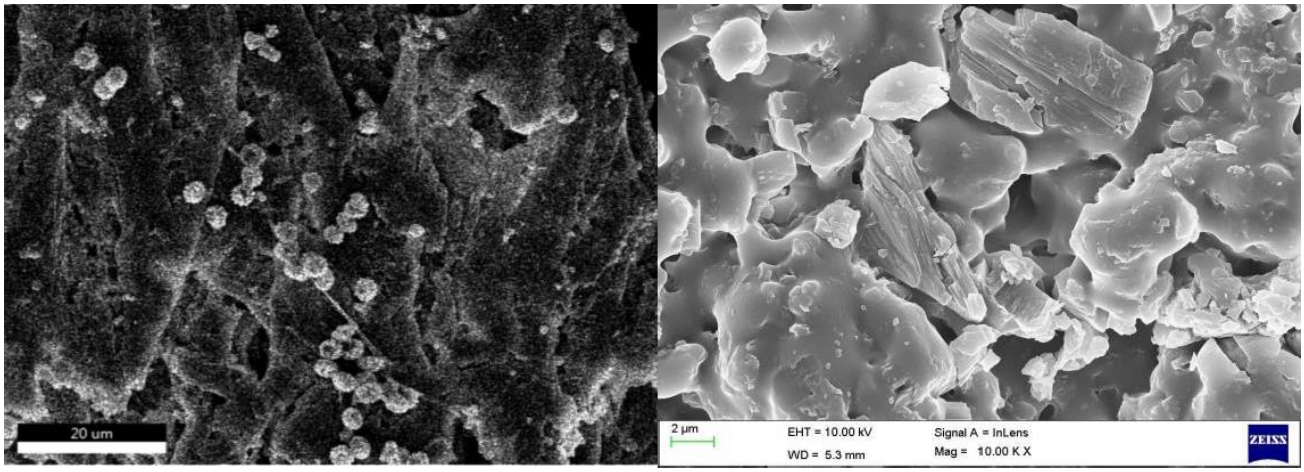


Figure 1: SEM of *Tridax Procumbens* and curcumin

Spreadability and Density

The Brookfield Viscometer model, LVDVE, is used to measure density. According to the report, the density of the gel was set to be 1288, 644, 429 SPL (*Tridax procumbens*) and 1287,643,428 SPL (curcumin) at an RPM of the pseudo-plastic gesture, which is a decrease in density with an increase in RPM, was then observed. As a result, the gel's density was optimized so that it could be applied topically.

The gel's spreadability was deemed high. The spread of gels determines their therapeutic effectiveness. The set gels must have good spreadability and meet the ideal quality in topical washability testing in order for the gel to function uniformly on the skin. After applying the formulation to the skin, it was thoroughly cleaned with tap water for ten minutes. The formulation demonstrated good washability and left no gel residue on the skin, suggesting that it is hydrophilic and simple to remove.

***In vitro* Antibacterial Efficiency:**

The *in vitro* antibacterial analysis was carried out by measuring the diameter of the zone of inhibition (mm) for the microsponge preparation Gel formulation which is presented in Table 2. The antimicrobial activity was tested individually for *S. aureus* and *E. coli* (gram-negative) and the zone of inhibition (See Figure 2). *Tridax Procumbens* Gel is effective against both gram (+) (-) bacteria and curcumin Microsponges based gel is effective on gram (+) bacteria. Microsponge-based gel is effective. S9 *(Tridax procumbens*) microsponge shows better antibacterial activity than S10 (curcumin) against both *E. coli* and *Staphylococcus aureus*, as indicated by the larger zones of inhibition at both concentrations (See Figure 3).

Table 2: *Invitro* anti-bacterial activity of Tridax Procumbens and Curcumin Microsponges based gel

		Zone of Inhibition (mm)	
Sl. No	**Organism Name**	***Tridax Procumbens* Microsponges Based Gel**	**Curcumin Microsponges based gel**
1	*E.coli*	27	20
2	*S.Aureus*	30	14

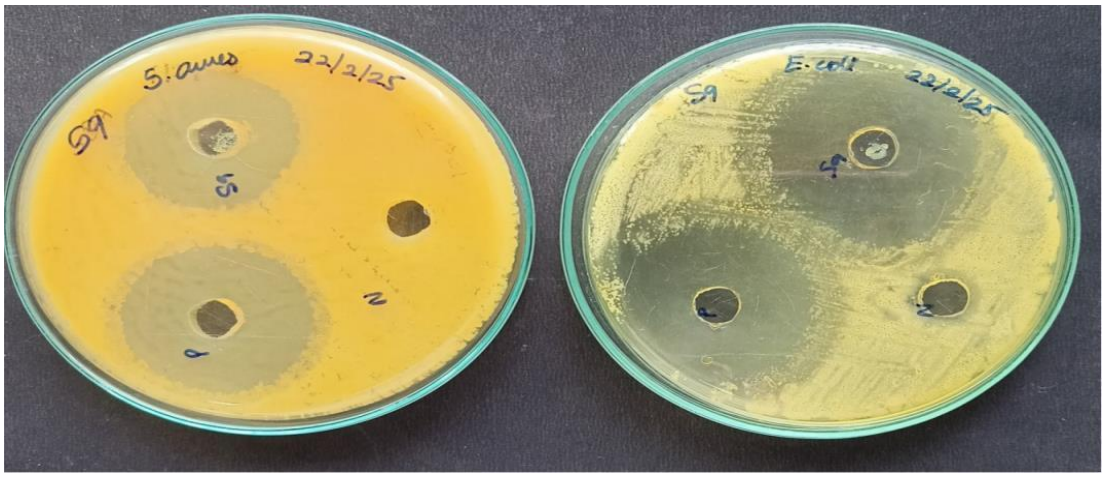


Figure 2: *Tridax procumbens invitro* anti-bacterial activity against *S. aureus* and *E. coli*

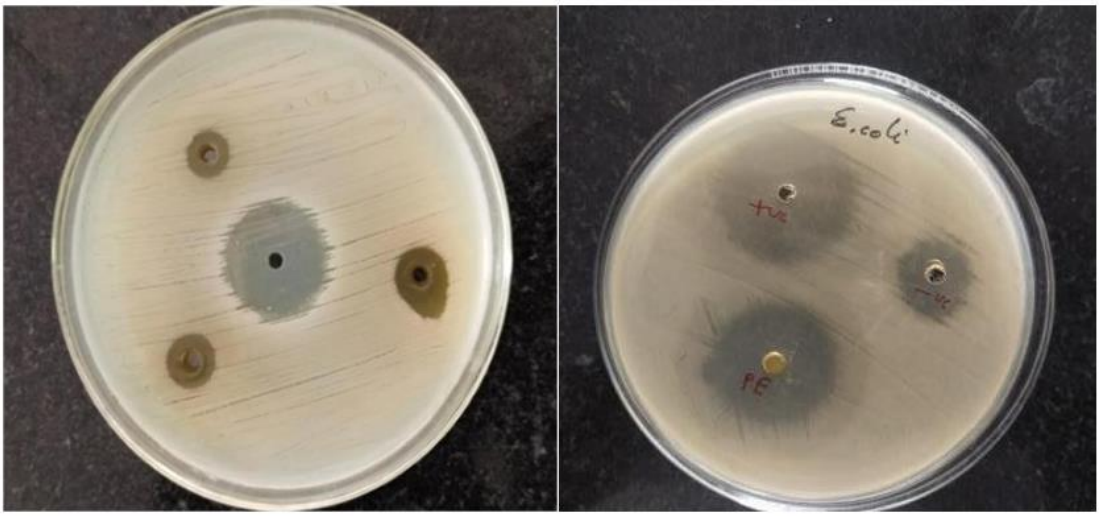


Figure 3: Curcumin *Invitro* anti-bacterial activity

Comparative Evaluation of Curcumin-and Tridax Procumbens Loaded Microsponge Gels

The comparative evaluation of curcumin- and Tridax procumbens-loaded microsponge gels revealed differences in their antibacterial activity, physicochemical properties, formulation characteristics, and overall performance for topical application. Curcumin, a polyphenolic compound known for its potential antibacterial and anti-inflammatory properties, was compared with T. procumbens extract, which contains phytoconstituents such as flavonoids, tannins, and alkaloids. According to the reported results, the curcumin-loaded gel demonstrated antibacterial activity, particularly against Gram-positive bacteria, whereas the T. procumbens-loaded gel exhibited activity against both Gram-positive and Gram-negative bacteria. The reported zones of inhibition were 10–14 mm and 10–12 mm for curcumin against Gram-positive and Gram-negative bacteria, respectively, compared with 20–27 mm and 20–26 mm for T. procumbens. These findings suggest that the T. procumbens-loaded formulation exhibited greater antibacterial activity under the tested conditions. See Table 3 for Comparative Evaluation Results.

However, confirmation requires the bacterial species, replicate measurements, and statistical analysis to be reported. Regarding microsponge characteristics, both formulations were described as spherical and porous, indicating their potential suitability for incorporating active ingredients. The production yield was higher for T. procumbens (71%) than for curcumin (50%), suggesting better recovery of the microsponge product under the conditions used.

Table 3: Comparative Evaluation between Curcumin and *Tridax procumbens*

Parameters	**Curcumin**	***Tridax Procumbens***
Active Compounds	Curcumin, a poly phenol with anti-inflammatory and anti-bacterial	*Tridax procumbens* extract (flavonoids, tannins, alkaloid with broad spectrum with anti-bacterial spectrum)
Anti-bacterial Spectrum	More effective against gram (+)	effective against both gram (+) (-)
Zone of Inhibition	Moderate zone (10nm-14nm) gram(+) (10nm-12nm) gram(-)	Longer zone (20nm-27nm) gram(+) (20nm-26nm) gram(-)
Microsponge Characteristics	Uniform, sporous, spherical microsponges, good entrapment of curcumin	Similar, porous, structure but slightly more rigid microsponges
Production Yield	50%	71%
Viscosity	1227.3 (SPL) mPas	Similar or slightly higher 1288 (SPL) mPas
pH	5.8-6.1	5.5-6.1
Appearance	Yellow Color Gel	Slightly Greenish Gel
Odor	Mild Pungent & Enhanced Organoleptic Characteristics	Mild Aromatic & Enhanced Organoleptic Characteristics
Consistency	Smooth and Glow	Smooth
Washability	Easily washable with water	Similar are better
Cost Effectiveness	Slightly Higher	More Economical
Storage Sensitivity	Sensitive to light	More stable in light
Skin	No irritation	No irritation
Spreadability	Good	Good

The viscosity values were 1,288 mPa·s for the T. procumbens formulation and 1,227.3 mPa·s for the curcumin formulation, indicating broadly comparable viscosities, with the former showing a slightly higher value. The pH values ranged from 5.8 to 6.1 for curcumin and 5.5 to 6.1 for T. procumbens, which are generally compatible with the mildly acidic environment of the skin. In terms of appearance and organoleptic properties, the curcumin gel was yellow with a mildly pungent odor, whereas the T. procumbens gel was slightly greenish with a mild aromatic odor. Both formulations exhibited smooth consistency, good spreadability, and easy washability, and neither showed skin irritation under the reported test conditions. The curcumin formulation was described as more sensitive to light and slightly more expensive, whereas the T. procumbens formulation was reported to be more economical and more stable under light exposure. Overall, the results indicate that both microsponge-based gels have potential for topical delivery, while the T. procumbens-loaded formulation showed a higher production yield and larger reported antibacterial inhibition zones. Nevertheless, additional stability studies, validated skin-compatibility assessments, and statistically supported antibacterial testing are needed before drawing definitive conclusions regarding their comparative effectiveness and suitability for clinical use.

CONCLUSION

The findings of the present study suggest that microsponge-based gel formulations containing curcumin and Tridax procumbens have potential as carriers for topical drug delivery. The prepared formulations exhibited acceptable physicochemical characteristics, including suitable pH, smooth consistency, and satisfactory spreadability, supporting their potential suitability for topical application. Both formulations demonstrated antibacterial activity against the tested bacterial strains. However, the T. procumbens-loaded microsponge gel exhibited larger zones of inhibition against both Gram-positive and Gram-negative bacteria than the curcumin-loaded formulation under the experimental conditions. In addition, the T. procumbens-loaded microsponges showed a higher production yield than the curcumin-loaded microsponges. These findings highlight the potential of T. procumbens as a plant-derived ingredient in microsponge-based topical formulations.

Nevertheless, further studies are required to confirm drug-release characteristics, long-term stability, skin safety, and therapeutic efficacy. Overall, microsponge technology represents a promising approach to developing topical formulations with potential antibacterial applications, although additional experimental and clinical evidence is needed before their therapeutic benefits can be established.

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REFERENCES

1. Jain KK. Drug delivery systems overview. Drug delivery systems. 2008:1-50.
2. Aggarwal P, Hall JB, McLeland CB, Dobrovolskaia MA, McNeil. Nanoparticle interaction with plasma proteins as it relates to particle biodistribution, biocompatibility, and therapeutic efficacy. Advanced drug delivery reviews 2009;61(6):428-437.
3. Jadhav N, Patel V, Mungekar S, Bhamare G. Karpe M, Kadams V. Microsponge delivery system: an updated review, current status and prospects. Journals Scientific Innovative Research 2013;2: 1097-11005.
4. Kumari Nidhi. Shubham Verma, Sokindra Kumar. Microsponge: An advanced drug delivery system. Published: 2021.
5. Kaity S. Maiti S, Ghosh AK, Pal D, Ghosh A, Banerjee S. Microsponges: A novel strategy for drug delivery system. Journal Advanced Pharm Technology Research 2010:1(3) 283-2907.
6. Shrivastava S, Kumar D, Kumar Dubey C. Pratap Singh S. Khinchi MP. A review: Microsponge: An effective drug delivery system. Asian Journal of Pharmaceutical Research Development 2017;5:1-08.
7. Rafiq Pinjaril, Shraddha Vaishnav, Dr. Gangurde Avinash B. Prashant Shevale, Sonawane Khyati, Dr. Vinod Bairagi Review article: Tridax Procumbens: Medicinal uses and Pharmacological activity, Phytochemical screening journals norms referred research 2024, 11 (3)
8. Parikh BN, Gothi GD, Patel TD, Chavda HV, Patel CN. Microsponge: A novel topical drug delivery system. Journal Global Pharma Technology 2010;2:17-29.
9. Joshi G, Kaur R, Kaur II. Microsponges: A novel drug delivery system IRJPBS2016;3:01-11.
10. Orlu M. Cevher E. Araman A. Design and evaluation of colon-specific Drug delivery system containing flurbiprofen microsponges. International Journal of Pharm 2006;318:103-117.
11. Meenakshi Bhatia, Megha Saini. Formulation and evaluation of curcumin microsponges for oral and topical drug delivery. Prog Biomater. 2018;7(2): 239-248
12. Antonova.V. Y, Peneva.P. T, Apostolova. E.G. *et al.,* Carbopol hydrogel/sorbitan monostearate-almond oil based organogel biphasic formulations preparation and characterization of biogels. Trop / Pharm Res. 2017;16(7): 1455-1463
13. Milla Gabriela Belarmino Dantas, Silvio Alan Gonçalves Bomfim Reis, Camila Mahara Dias Damasceno *et al.,* Development and evaluation of stability of a gel formulation containing the monoterpene borneol. Sci World 1. 2016:8(3):1-4
14. Nirmala M.J, Durai L, Gopakumar V et ol, Preparation of celery essential oil-based nanoemulsion by ultrasonication and evaluation of its potential anticancer and antibacterial activity. Int J Nanomedicine. 2020;15(2):7651-7666
15. Asad M.I., Khan D. Rehman, Elaissari A *et al.,* Development and in vitro/in vivo evaluation of pH-sensitive polymeric nanoparticles loaded hydrogels for the management of psoriasis. Nonomaterials 2021; 11(12): 3433-3438
16. Muhammad Ubaid, Sadif Ilyas, Sadullah. M. et al, Formulation and in vitro evaluation of carbopol 934-based modified clotrimazole gel for topical application. An Acad Bras Clenc 2016, 88(4): 2303- 2317.

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