IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

FORMULATION AND EVALUATION OF HERBAL LOADED MICROSPONGES CAPSULES

[1]NEERAJ KUMAR, [2] PORF.DR. MD.SEMIMUL AKHTAR

[1]Student of M.Pharma, Shri Ram Murti Smarak College of Engineering, Technology

Bareilly

[2](Professor) Gitanjali college of pharmacy, birbhum-731237,West Bengal India.

Abstract; The ethnomedicinal usage of Bryophyllum pinnatum leaves in urinary problems was validated by their ability to inhibit the development of renal calculi. Also it backs up their therapeutic potential to treat kidney stones. Mine goal in developing a polymeric microsponge delivery system would have been to equally spread *Bryophyllum pinatum* over a long period of time, reduce administration frequency, and maximise bioavailability. These Microsponges are then placed within capsules of the "1" size. As both a consequence, *Bryophyllum* Microsponges capsules were produced employing a simple, reproducible, yet quick quasiemulsion solvent diffusion strategy in this study. Inside the prepared Microsponges, FTIR, SEM, drug content, particle size analysis, as well as loading yield were determined. *Bryophyllum microsponges* were again embedded in kidney stones to test their release. The particle size , drug release behaviour of both the generated Microsponges were demonstrated to be regulated by the drug polymer ratios, stirring rate, that volume of dispersed phase, but that the presence of the an emulsifier was required for microsponge production. These findings revealed that increasing overall drug-polymer ratio resulted in a decrease with in release rate of Microsponges capsules, that was attributable towards the Microsponges' internal porosity.

Key words: Microsponges delivery system, Control release, Oral drug delivery system,Quasi-emulsion solvent diffusion, Byrophyllum pinnatum,

1.INTRODUCTION

1.1 DISCOVERY OF MICROSPONGE DRUG DELIVERY [1]

The introduction of new medications is no longer adequate for drug treatment in today's world. However, it also entails the creation of a proper medication delivery mechanism at the point of action.That delivery systems, that provides for a controlled and sustained release of the active substance per the therapy's individual demands, also plays a role in the dosage in-vivo fate.Too far, the most difficult problem has been to regulate the delivery rate of pharmaceuticals using a variety of current technology and substantial study.

Transmitter innovation could be the answer to such problems. More and more research is being done on Microcapsules and nanotechnology in order to achieve targeted and longterm pharmaceutical release. Microspheres, liposomes, and nanoparticles, for example, modify the drug's absorption and release properties. Microspheres are unable to control the pace at which a medication is released. The medicine contained within microspheres will be released after the outer shell is ruptured. Liposomes have drawbacks such as decreased drug trapping, complexity in formulating formulations, and inadequate physicochemical and microbial durability, needing antioxidants.The majority of the benefits in topical medication delivery come from solid lipid nanoparticles. Inhalation or ingestion of nanomaterial, as well as skin absorption, can quickly enter the systemic circulation, especially if the skin is injured. After entering the circulation, nanomaterial can be moved about the body and absorbed by major organs including the brains, lungs, stomach, kidney,spleen, bone marrow, and central nervous.

Microsponge-based polymers nanoparticles offer a novel solution to issues associated to technological breakthroughs. Microsponges are indestructible, neutral microspheres that don't really penetrate the skin. Rather, they collect in the skin's microscopic nooks and crevices, softly releasing the entrapped medication as needed. They're designed to provide a pharmaceuticals ingredient at a low dose while also enhancing stability, decreasing adverse reactions, and altering drug delivery. Nanosponges are small microspheres that absorbed skin liquids, reducing sebum production and gloss on the skin. Spherical particles made up of clusters of even tinier spheres can make up nearly twice the amount of epidermal secretions. Consumers may buy these items in traditional forms like creams, gels, or lotions, and they feature a high concentration of drug chemicals. Their usefulness for oral medication administration has recently been studied. This article covers the

construction, development, uses, and future of Microsponges in a systematic and unambiguous manner. Its purpose is to provide an overview of the tremendous amount of research that has been done in the subject of Microsponges, as well as the numerous prospects that exist.

1.2 MICROSPONGE DRUG DELIVERY SYSTEM

In current history, increased attention is placed on creating innovative Microsponge-based pharmaceuticals to regulate and alter drug release behavior. By putting it into a delivery system, it is possible to alter the therapeutic index and duration of medicinal activity.Won invented the Microsponge technique in 1987, and Advanced Polymer Systems, Inc. was given the original patents. Microsponges are porous microsphere-based polymeric delivery devices. These have a rough structure and are circular hydrogel particles. They may serve to strengthen medicine stability, reduce side effects, and change drug release for the better. Microsponge technology has a numerous advantages that make it a useful medication delivery mechanism. The internal structure of the microsponge particle is exposed by scanning electron microscopy as a "bag of marbles." The interstitial spaces between the marbles are responsible for the porosity. Emollients, perfumes, interstitial pores can trap lavender oil, sun protection, generally pro and anti-inflammatory medicines, and other active chemicals. These imprisoned Microparticles can then be included or produced into a variety of goods, including creams, lotions, powders, soaps, capsules, and tablet.[2]

This average 25-meter spherical may contain approximately to 250000 particles and a 10- foot-long internal high porosity, making it a total porous structure of about 1 ml/g. As both a result, every Microsponge has a massive reservoir capable of holding up to one's own value in active layer. These multilayered structure substances are deemed innocuous since the microsponge granules are too big to be assimilated by the skin. A possible bacterial contamination of the Microsponge's elements is also a safety problem. Because of pore diameter is narrower, Microorganisms with pore sizes ranging from 0.007 to 0.2 m are unable to enter the Microsponges' tube construction.[3-5]

1.2.1 Potential features of microsponge drug delivery system [6,7]

a) It's really stable throughout a pH range of 1 to 11.
b) Temperature stability up to 130oC.
c) Many vehicles and active substances are compatible with it.
d) Because their typical pore size is 0.25m, bacteria cannot penetrate them, they are selfsterilizing.
e) A greater payload (50 to 60 percent).
f) Free-flowing and budget-friendly.
g) Demonstrate good compatibility with a wide range of vehicles and ingredients.
h) Can absorb up to 6 times their weight in oil and not dry out.
i) Characterized by its ability to flow freely.

1.2.2 Benefits of Microsponge Drug Delivery System[8,9]

a) Product performance has been increased, the release time has been extended, and the discomfort has been reduced, resulting in greater patient compliance.
b) Elegance of the product has improved.
c) Flexibility in formulation has been improved.
d) Thermodynamic, physiological, and chemical inertness have almost all gotten better.

1.2.3 Oral drug delivery[10]

1. Preserve the active constituents in a safe environment and transfer them to the lower GIT via oral controlled delivery.
2. Microsponge systems entrap weakly soluble medicines in their porous structure,improving their solubility.
3. Because the Microsponge’s porous structure is so small, the medications entrapped will be reduced to minuscule particles with a higher surface area, resulting in a faster rate of dissolution rate.
4. Reducing overall time it would take this Microsponge mechanism to pass through the colon will increase the quantity of medicine that is absorbed.

2. Material used and Experimental Design

Table No .1: The following is a list of the drugs and excipients used in this trial, as well as their manufacturers and roles.

INGREDIENTS	MANUFACTURER	ROLE IN FORMULATION
Ethylcellulose	A.B Enterprises	Polymer
Polyvinyl alcohol	Labdhi Chemicals	Stabilizing agent
Ethanol	Otto Chemie Pvt.Ltd	Solvent
Magnesium stearate	Sankalp Pvt.Ltd	Lubricant

TABLE .2: Equipment used in formulation and evaluation of Microsponges

S.No.	Equipment	Make/ model/ source
1	Soxhlet Apparatus	ABGIL/INDIA
2	Tray dryer	Kerone
3	Magnetic stirrer	Remi 10ML DX
4	UV spectroscopy	Shimadzu UV-1800
5	Microscope	LB-M09
6	Dissolution apparatus	Electro lab TDT-08L
7	FTIR	Schimadzu FTIR model IR 8400S
8	SEM	JSM 6100
9	XRD	X' Pert Pro
10	Hot air oven	BST/HAO-1122
11	Digital pH meter	Max ME-962-P
12	Manual capsule filers	Li-cfm 300

2.1.1 Extraction of *Bryophyllum pinnatum* leaves [11]

Using ethanol as a solvent, a known amount of dried *Bryophyllum pinnatum* leaves were exposed to the Soxhlet process to get extract. After two days, the acquired extract was evaporated by placing it in the oven, yielding a crude green-colored semi-solid extract.

2.1.2 Phytochemical Evaluation of Plant Extract

The phytochemicals in an ethanolic extract of *Bryophyllum pinnatum* leaves were evaluated qualitatively by dissolving a minimal fraction of extract in ethanol, which was then utilized for the following detection: **Querectin**: A little quantity of leaf extract was carefully combined with 2ml chloroform and 3ml conc. H2SO4 to create a layer of reddish-brown colour that confirmed the existence of **Querectin.**

2.2 PROCEDURE TO FORMULATE MICROSPONGES [12,14]

1. Internal phase: 25mL Ethanol was used to dissolve the polymer Ethyl Cellulose. The *Bryophyllum pinnatum* extract was added and well stirred until it was completely dissolved.

2. External phase: To make a transparent solution, accurately weighed PVA is mixed with distilled water.

3. At room temperature, the internal phase was introduced to the exterior phase and agitated for 6 hours.

4. Sometimes the samples were filtered for extract Microsponges, which would then be dried for 12 hours inside of an oven heated oven at 40°C before being stored for further investigation.

Formulation of Microsponges

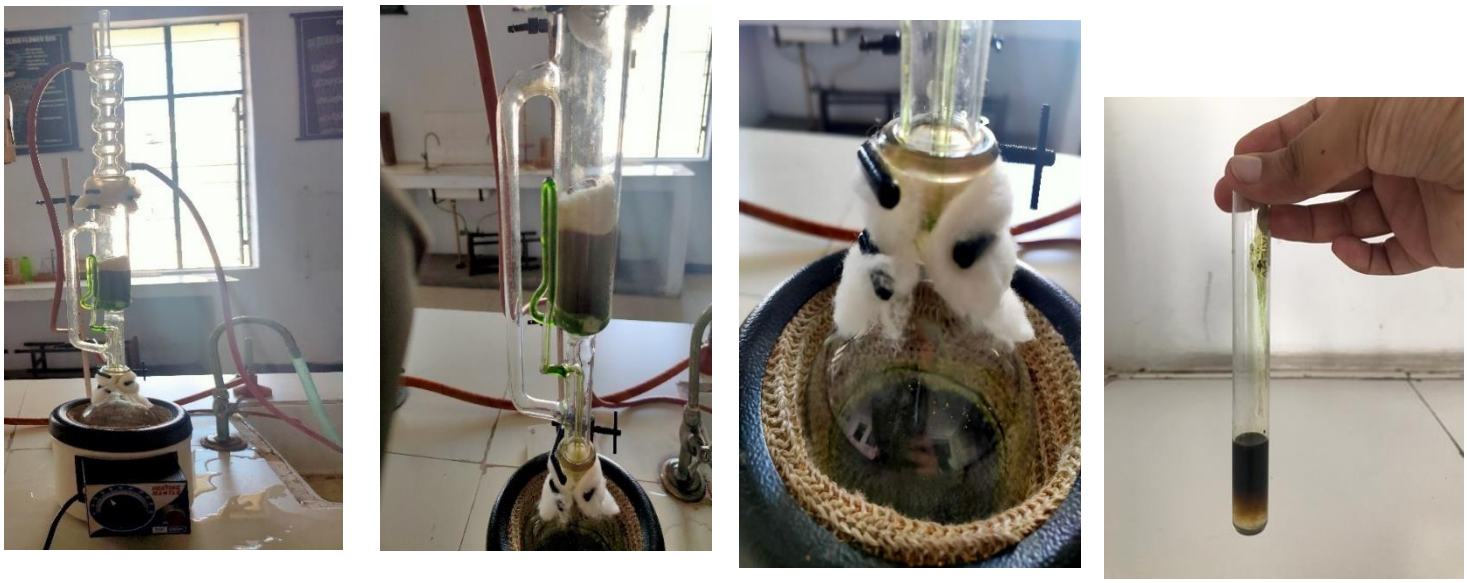
Table .3: Composition of *Bryophyllum pinnatum* Microsponges

Ingredient	**M1**	**M2**	**M3**	**M4**	**M5**
***Bryophyllum pin*(mg)**	100	200	300	400	500
Ethyl cellulose(mg)	500	500	500	500	500
Polyvinyl alcohol (mg)	1000	1000	1000	1000	1000
Ethanol (ml)	25	25	25	25	25
Distilled water (ml)	100	100	100	100	100

3. RESULTS AND DISCUSSION

3.1 Extraction of *Bryophyllum pinnatum* leaves

Using ethanol as a solvent, a known amount of dried leaves of *Bryophyllum pinnatum* were exposed to the Soxhlet apparatus to get extract. As a conclusion, a crude green-colored semi-solid extract was produced.



A layer of reddish-brown coloration, verifying the presence of Querectin.

Fig. 1: Test for Querectin present in *Bryophyllum pinnatum* leaves extract

3.2 STANDARD GRAPH OF BRYOPHYLLUM PINNATUM [15]

Bryophyllum pinnatum extract solutions in Phosphate buffer pH 7.4 were diluted to yield concentrations ranging from 2 to 20 µg/ml. At 205nm, the absorbances were measured, the results are listed in table no 5.1.

Table .4: Absorbance of *B.pinnatum* extract in Phosphate buffer pH 7.4

S.No	Concentration(µg/ml)	Absorbance
1	2	0.057
2	4	0.058
3	6	0.062
4	8	0.068
5	10	0.074
6	12	0.088
7	14	0.105
8	16	0.110
9	18	0.104
10	20	0.099

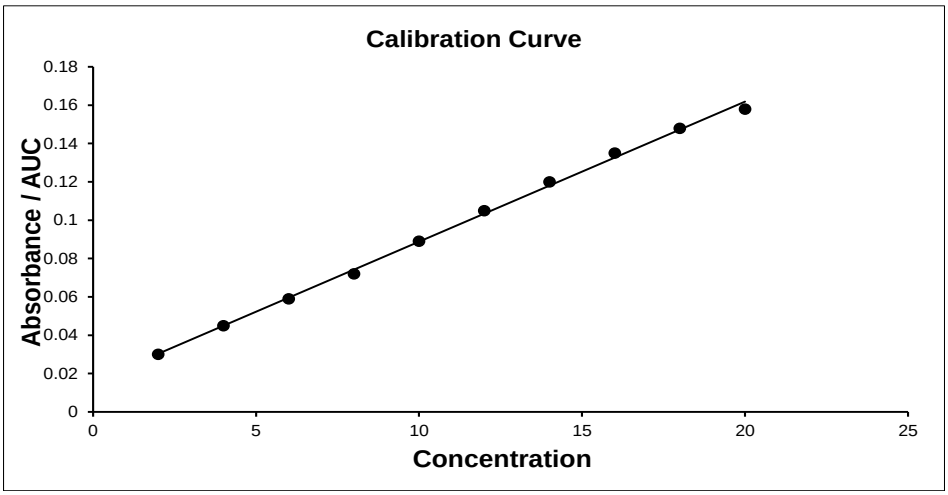


Fig. 2: Standard graph of Bryophyllum in phosphate buffer pH 7.4

At quite a dosage of 2-10g/ml, these solutions demonstrate linearity (R2=0.999) for absorption and fulfil Beer Lambert's law.

3.3 FTIR STUDY

That product's interactions only with excipients with in formulation were investigated. And following are indeed the outcomes

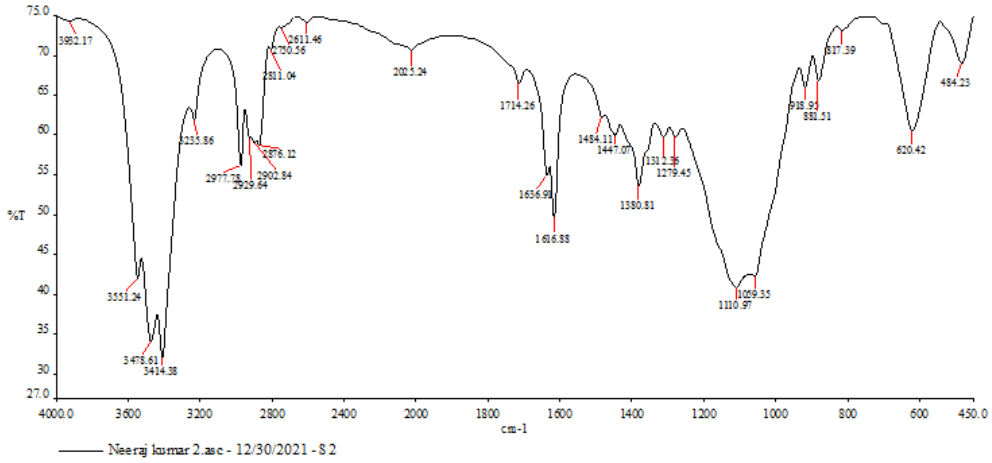


Figure .3: FTIR spectrum of *Bryophyllum pinnatum*

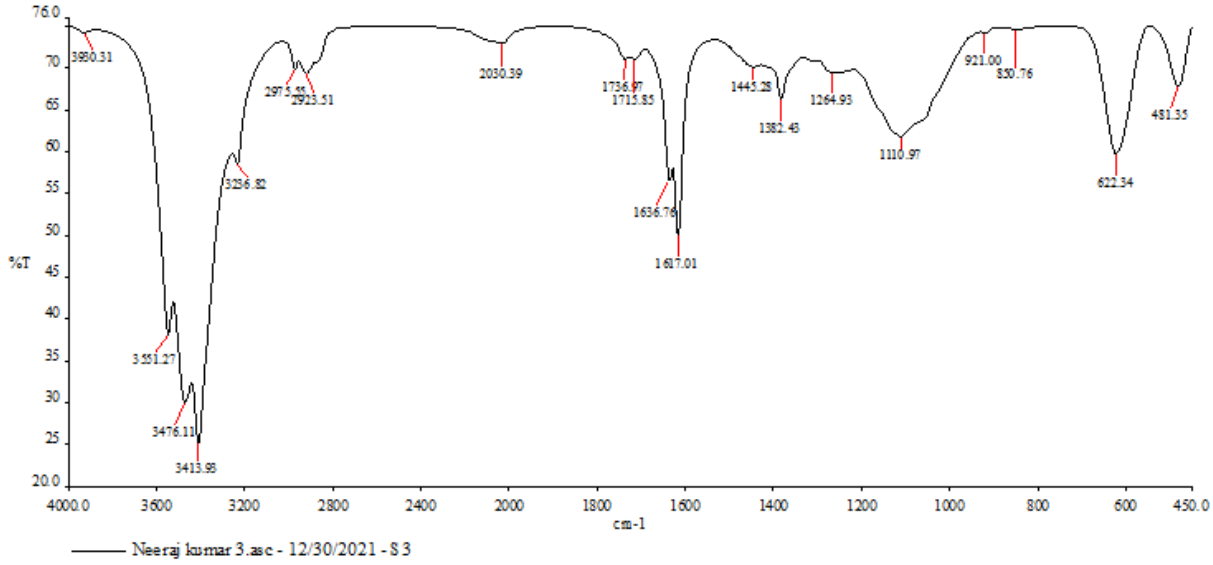


Figure .4: FTIR spectrum of ethyal cellulose

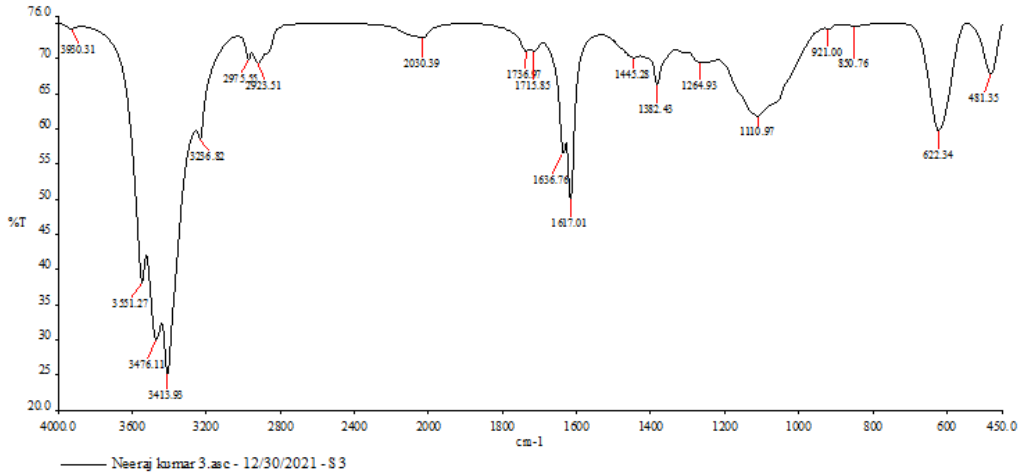


Figure .5: FTIR spectrum of polyvinyl alcohol

3.4 PREPARATION OF BRYOPHYLLUM PINNATUM MICROSPONGES

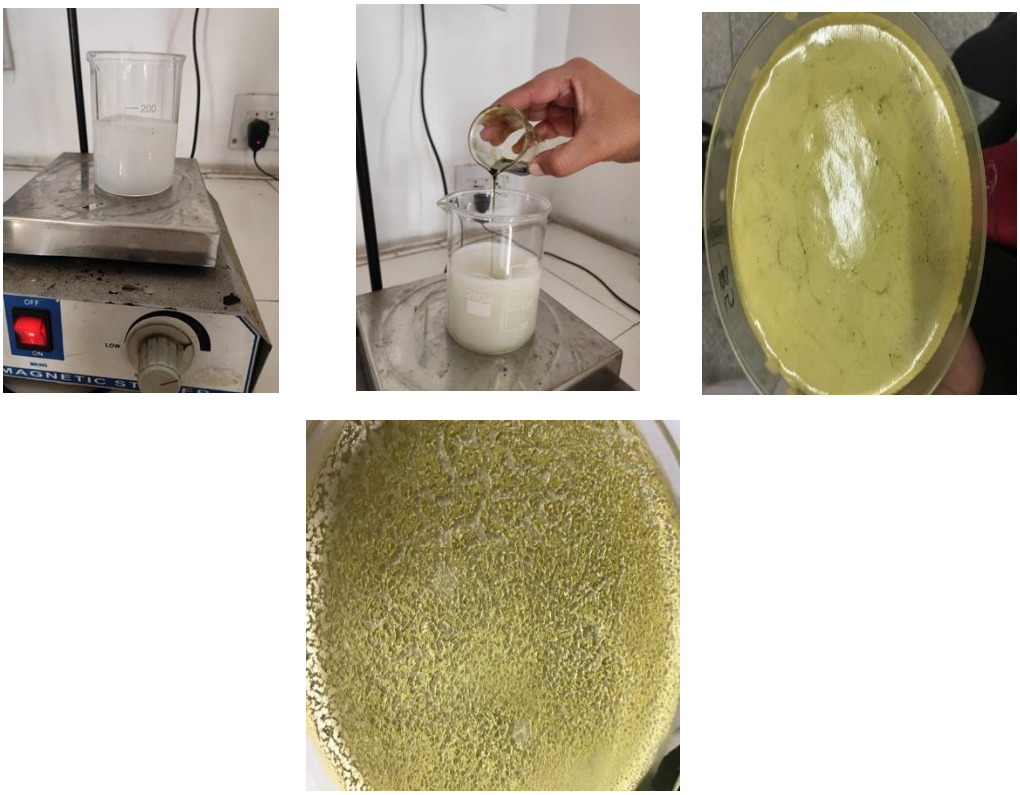


Fig. 6: Different stages of preparation of *Bryophyllum pinnatum* Microsponges.

3.4.1 PRODUCTION YIELD MICROSPONGES

Over all batches of Microsponges had a production yield ranging from 65.5 % to 79.5 % (Table 5.2). The drug polymers ratio,drug concentration were shown to have a substantial impact on manufacturing yield. The manufacturing yield for drug polymers ratio 1:10 (M1) was 67.5 percent, whereas it was 79.5 percent for drug: polymer ratio 5:10 (M5). The higher of the drug-to-polymer ratio, the higher the manufacturing yield. The following formula was used to calculate the production yield.

Table No .5: Production Yield Microsponges

Batch Code	Theoretical Mass (g)	Practical Mass (g)	Production Yield (%)
M1	1.6	1.08	65.5
M2	1.7	1.19	68.4
M3	1.8	1.38	76.6
M4	1.9	1.47	77.3
M5	2.0	1.59	79.5

3.4.2 LOADING EFFICIENCY

Table .6: Loading efficiency

Formulation code	Loading efficiency (%)
M1	67.42
M2	71
M3	78
M4	94
M5	96

Skills and knowledge in order varied from 67.42 % to 96 percent. The formulations M4 and M5 had the highest loading efficiency. This demonstrates that raising the drug-to-polymer ratio improved loading efficiency. The findings are consistent with previous publications.[16]

3.4.3 PARTICLE SIZE OF MICROSPONGES

Table .7: Average particle size of Microsponges

S.No.	Formulations	Average particle size (µm)
1	M1	40.15
2	M2	42.16
3	M3	45.12
4	M4	48.29
5	M5	52.50

The particle size distribution were found in the range of 40.15m to 52.50m based on the following findings. As the drug-polymers ratio rises. The particle size decreases. The findings are consistent with previous publications.[17]

3.4.4 SEM

SEM analysis was used to investigate the shape and surface topography of produced Microsponges. Figure 5.7 shows a recorded SEM picture of Microsponges. Microsponges generated were very porous, according to SEM data. Furthermore, the unique interior structure was revealed to be a spherical chamber containing a rigid shell made of drug and polymer. The inside structure was made up of countless unfilled gaps, and the particles had the appropriate look to be called Microsponges.[18]

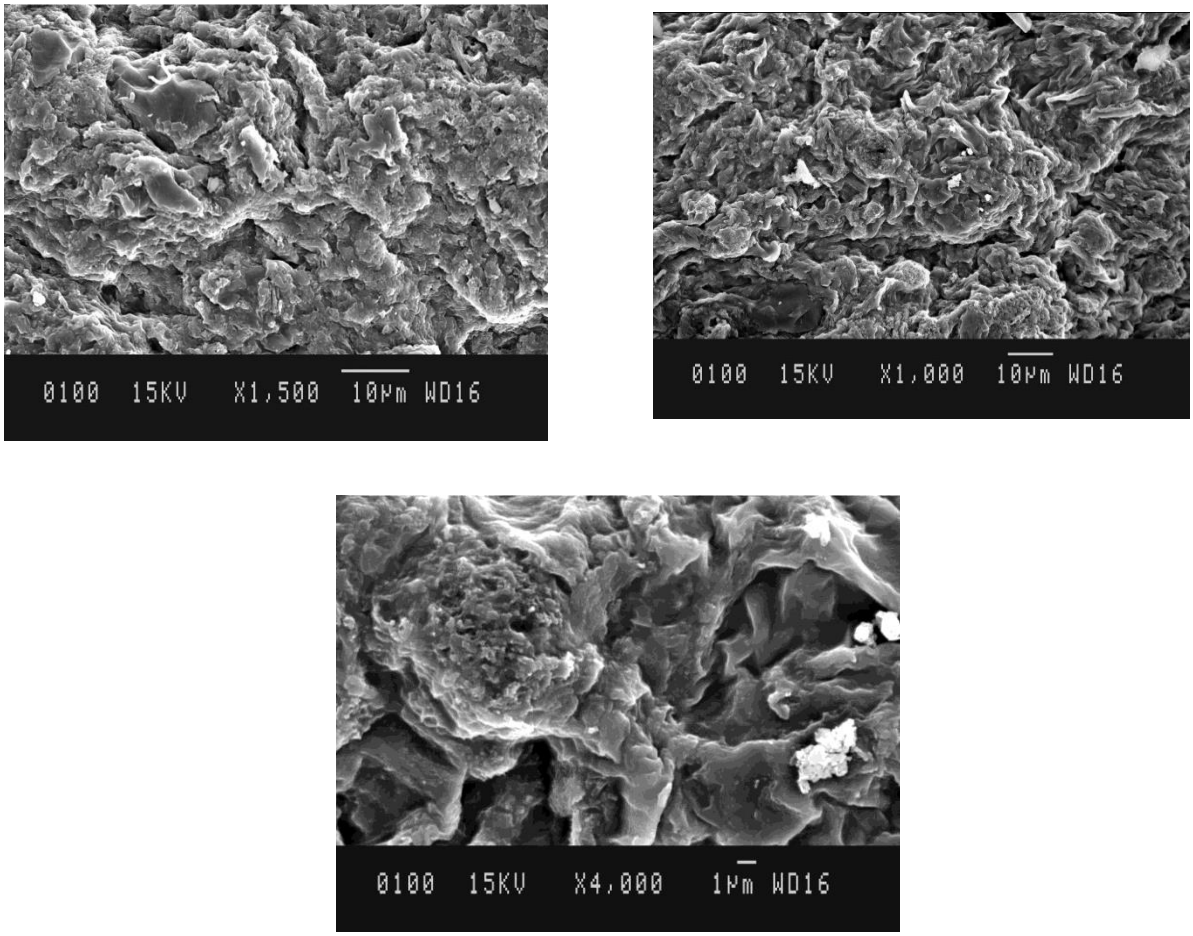


Fig. 7: SEM

3.4.5 XRD

The physicochemical parameters of produced Microsponges were evaluated using the X-ray powder diffraction (XRPD) technique. In X-ray diffractograms of Bryophyllum Microsponge formulation, sharp peaks at diffraction angle (2h) 30.5 were traced. The final Microsponge formulation had peaks at diffraction angles, indicating that it was crystalline.[19]

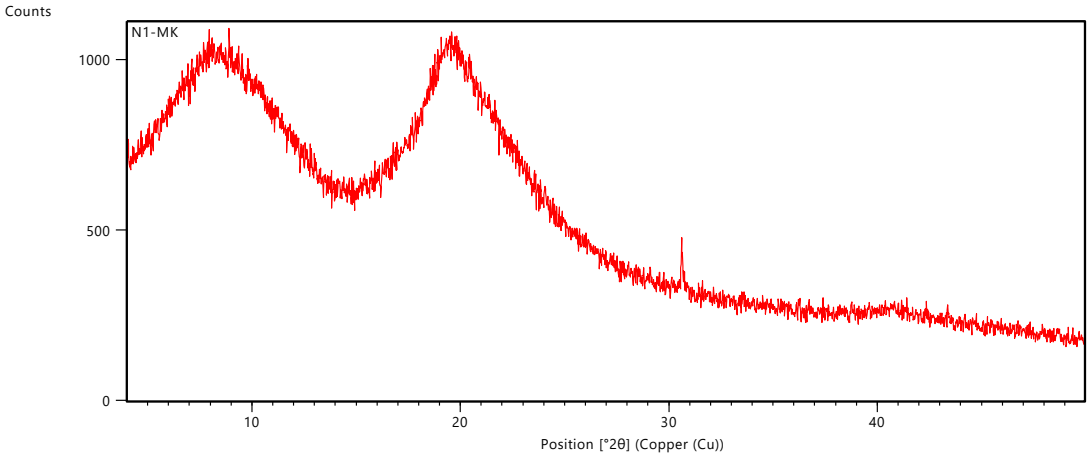


Fig .8:XRD

Table .8: In-vitro drug release study of Microsponge formulation

Time (Hrs)	M1	M2	M3	M4	M5
0	20.97	21.90	22.08	24.80	0
2	27.44	28.68	30.23	31.29	17.49
4	34.67	31.36	42.65	43.76	27.70
6	44.57	46.63	58.14	60.24	45.49
8	50.18	54.42	66.48	68.86	53.15
10	61.63	62.05	70.58	71.38	60.59
12	71.67	73.76	73.65	72.89	75.10
16	72.56	75.70	76.09	77.89	83.09

3.4.6 RELEASE KINETICS OF THE OPTIMIZED FORMULATION

Table .9: Release kinetics of the optimized formulation (M5)

Time (H)	Cumulative % drug released	% drug remaining	Square root time	log Cumu % drug remaining	log time	log Cumu % drug released	% Drug released	Cube Root of % drug Remaining(Wt)	Wo-Wt
0	0	100	0.000	2.000	0.000	0.000	100	4.642	0.000
2	17.49	82.51	1.000	1.917	0.000	1.243	17.49	4.353	0.289
4	27.71	72.29	1.414	1.859	0.301	1.443	10.22	4.166	0.476
6	45.50	54.5	1.732	1.736	0.477	1.658	17.79	3.791	0.851
8	53.16	46.84	2.000	1.671	0.602	1.726	7.66	3.605	1.037
10	60.60	39.4	2.236	1.595	0.699	1.782	7.44	3.403	1.239
12	75.11	24.89	2.449	1.396	0.778	1.876	14.51	2.920	1.722
16	83.10	16.9	2.646	1.228	0.845	1.920	7.99	2.566	2.076

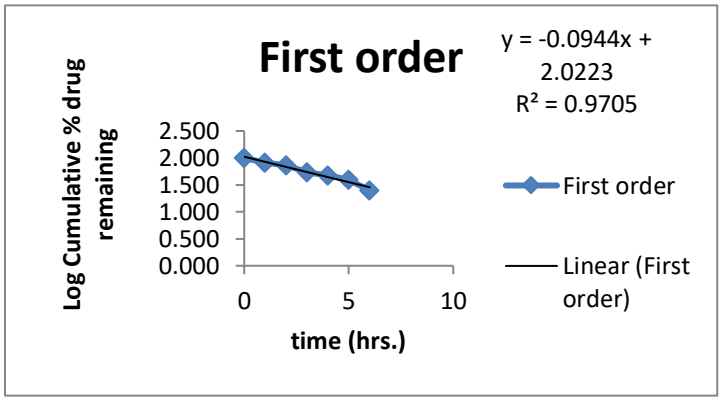


Fig.9: A Plot of First order kinetics

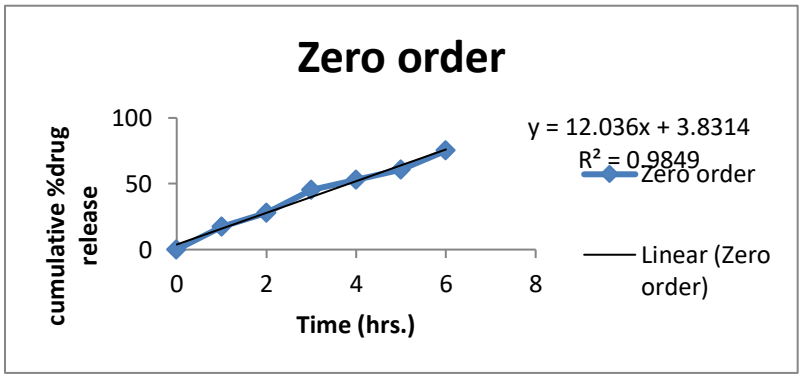


Fig. 10: A Plot of Zero order kinetics

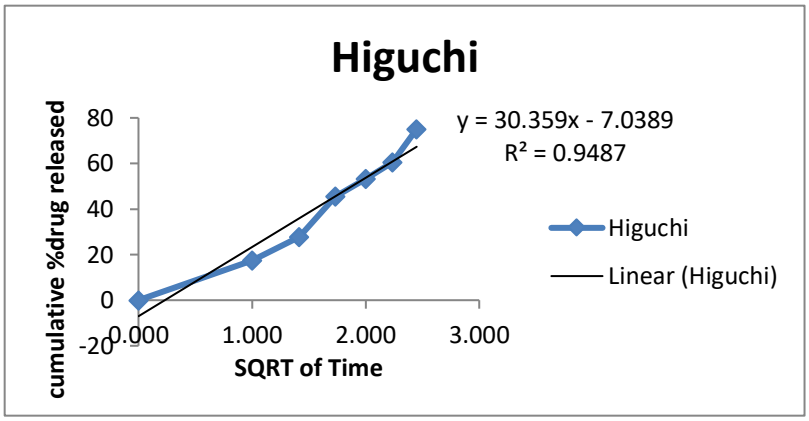


Fig.11: A Plot of Higuchi release kinetics

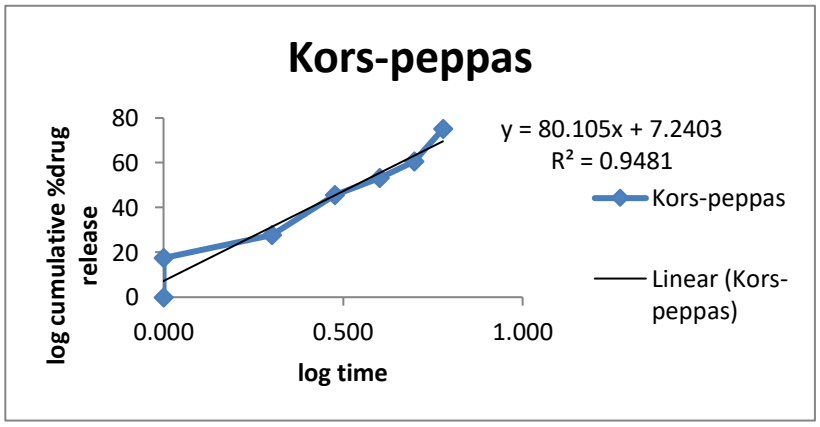


Fig . 12: A Plot of Korsemeyer- Peppas kinetics

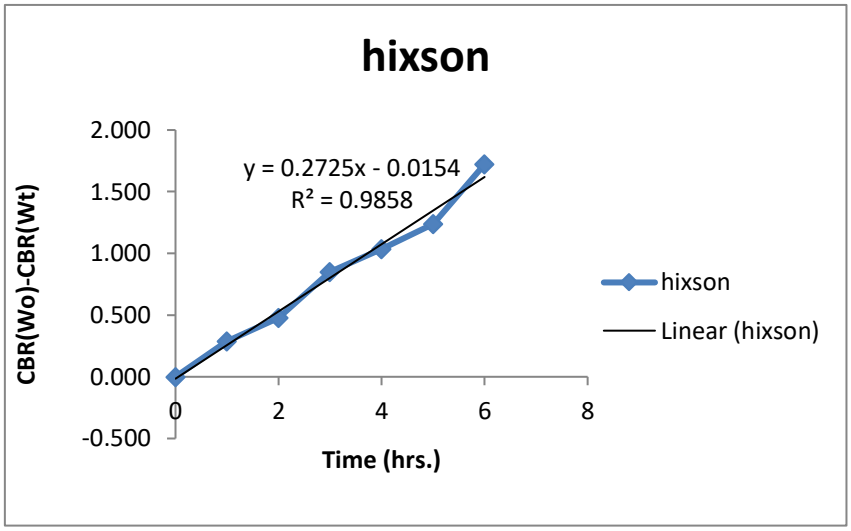


Fig. 13: A Plot of Hixson- Crowell kinetics

Its significance level (R2) is being used as a criterion that select the best model. Table No.5.15 shows the R2 values of several models.

Table .10: R2 values of various kinetics models

Kinetics models	Coefficient of determination (R2)
Zero order	0.984
First order	0.970
Higuchi	0.948
Korsemeyer and Peppas	0.948
Hixson Crowell	0.985

So because graphs revealed proportionality (R2=0.984), Zero order kinetics has been the best explanation for an in release of drug of the improved formulation M5. That regulated release of both the produced Microsponges more than a period of time be explained through this zero order kinetics.[20,21]

4.Conclusion

My idea of creating a polymers microsponge delivery method was to distribute *Bryophyllum pinnatum* inside a sustained way for such a prolonged duration of time, minimize administration frequency, plus increase bioavailability. As either a result, *Bryophyllum* Microsponges are generated in this work using a simple, repeatable, but fast quasi-emulsion solvent diffusion approach. FTIR, SEM, or XRD examinations were used to describe its formulation.

Microsponges being created then inserted inside capsules of the "1" size. The chemical compatibility analysis (FT-IR) was performed. There was no evidence of such a drug-excipient interaction for Bryophyllum. A standard graph were produced, and that was discovered that perhaps the solutions were linear (R2=0.999) that followed Beer Lambert's law. Bryophyllum and seeing which polymer retards its release the best, Microsponges were made using two different polymers.

Particle size, overall drug content, overall encapsulation efficiency were all affected by the drugpolymer ratios. This batch M5 has a 96 percent entrapment efficiency as well as a production yield at 79.5 percent.Applying Zero-order release kinetics using dissolution method of control of drug release, Bryophyllum Microsponges released 92.10 percent of Microsponges in an 8-hour research. Despite increasing overall drug-polymer ratios, solvent quantity, emulsifying agents, overall rate of stirring over optimized Microsponges, M5 were identified as the best formulation since it produced the best outcomes. For the medication with M5 Microsponges, the Preformulation research was done. It must have been discovered that now the pure medication had a poor flow quality, however the Microsponges had an excellent flow.These capsules' post-formulation variables were evaluated, as well as the findings proved confirmed be meet their approved standards. An M5 formulation with such a 5:1 drug: polymer ratio and Ethyl cellulose generated Controlled release, as per the findings.

Acknowledgement

I take this opportunity to express my heartiest gratitude to my guide Dr.Md. Semimul Akhtar (Professor) Department of Pharmaceutics, SRMS CET (Pharmacy), Bareilly, for his inspiring guidance and keen interest shown towards my work. I am cordially thankful for his efforts in helping me to complete this work successfully. I deeply convey my regards to my entire faculty members for their inspiration, support and valuable suggestions throughout the course of my work and beyond that

REFRENCES

1. Namrata Jadhav, Vruti Patel, Siddesh Mungekar, Gaurav Bhamare, Manisha Karpe, Vilasrao Kadams. Microsponge Delivery System: An updated review, current status and future prospects. Journal of Scientific and Innovative Research. 2013; 2 (6): 1097-1110.
2. 21.Sandhyarani Sagavkar R, Shrinivas Mohite K. Innovative And Novel Strategy: Microsponges Drug Delivery System . International Journal of Universal Pharmacy and Bio Sciences 2014; 3(4):79-92.
3. Charde MS, Ghanawat PB, Welankiwar AS, Kumar J, Chakole RD. Microsponge A Novel New Drug Delivery System: A Review. International Journal of Advances in Pharmaceutics.2013; 2 (6) :63-70.
4. Kapoor D, Vyas RB, Lad C, Patel M, Tyagi BL. A Review On Microsponge Drug Delivery System . Journal of Drug Delivery & Therapeutics. 2014; 4(5): 29-35
5. Shyam Sunder Mandava and Vedavathi Thavva. Novel Approach: Microsponge Drug Delivery System. International Journal of Pharmaceutical Science and Research, 2012; 3(4): 967-980. 25.Charde MS, Ghanawat PB, Welankiwar AS, Kumar J, Chakole RD. Microsponge A Novel New Drug Delivery System: A Review. International Journal of Advances in Pharmaceutics.2013; 2 (6) :63-70.
6. Yerram Chandramouli , Shaik Firoz, Rubia Yasmeen, Amaravathi Vikram, Mahitha B, Aruna U. Microsponges: A Novel Drug Delivery System For Controlled Delivery Of Topical Drugs. International Journal of Pharmaceutical Research & Analysis . 2010; 2 (2): 79-86
7. Hibah Aldawsari and Shaimaa Badr-Eldin .Microsponges as promising vehicle for drug delivery and targeting: Preparation, characterization and applications. African Journal of Pharmacy and Pharmacology.2014; 7(17): 873-881.
8. Manisha K Tile and AY Pawar. Microsponges: A novel strategy for Drug delivery.International Journal of Pure and Applied Biosciences.2015; 3 (1): 224-235.
9. Rastogi V, Shukla S., Singh R, Lal N, Yadav P: Microspheres: A promising drug carrier. Journal of Drug Delivery and Therapeutics (2016); 6(3):18-26.
10. Vyas L.K., Tapar K.K., Laddha B.H., Lahoti A.O. , Nema R.K.Formulation and development of anti-blemish preparation using microsponge technology. J. Chem. Pharm. Res. 2010; 2(5):562-571.
11. James Redfern1, Malcolm Kinninmonth1, Dariel Burdass2, And Joanna Verran1 * 1 School Of Health Care Science, Manchester Metropolitan University, Manchester, Uk, 2society For General Microbiology, Reading, Uk Using Soxhlet Ethanol Extraction To Produce And Test Plant Material (Essential Oils) For Their Antimicrobial Properties Journal Of Microbiology & Biology Education, May 2014, P. 45-46
12. Ramadevi Bhimavarapu, Karuna Priya Chitra, Karunkiran P, Raviteja G, Meharagavendra Y, Sundaramma.S. Itraconazole loaded microsponges- A novel carrier system. International Journal of Inventions in Pharmaceutical sciences. 2015; 3(1): 953-957.
13. Ramani Gade, Anitha Makineni, Aparna.A, Krishna Keerthi B, TEGK Murthy, Chandu Babu Rao, Sreekanth. Design and development of Hydroxyzine hydrochloride controlled release tablets based on Microsponge technology. Carib.J. Sci Tech. 2013; 1(1): 172-184.
14. Patel Krushika Sendhabhai and Sunita Chaudhary. Formulation and Evaluation Of Bioadhesive Buccal Tablet Of Diacerein. International Journal of Pharmaceutical Research and Bio Science. 2014; Volume 3(2): 860-879.
15. United States Pharmacopoeia, 30th edition NF 25-2007. The Official Compendia of Standards. 643, Pharmacopoeial forum 32(1): 141
16. Manavalan R and Ramasamy C. Physical Pharmaceutics. Vignesh publisher.2007:332
17. Indian Pharmacopoeia,Ministry of Health and Welfare department,Ghaziabad, India. The Indian Pharmacopoeia Commission.2014; Vol 2:929-930.

18. Roaa Nief and Ahmed Hussein. Preparation and Evaluation of Meloxicam Microsponges as Transdermal Delivery System .Iraqi Journal of Pharmaceutical Sciences.2014; 23(3):63-74.

19. Ashwini S Bansode1, Vaishnavi B Kute1, Komal S Vethekar1, Priyanka S Kote1, Monika K Varhadi1, Ajit S Bansode1, Suresh L Jadhav1, Nitin V Devhadrao2.Formulation, development and evaluation of Microsponge loaded Topical Gel of NystatinJournal of Drug Delivery & Therapeutics. 2019; 9(2-s):451-461

20. Ashwini S Bansode1, Vaishnavi B Kute1, Komal S Vethekar1, Priyanka S Kote1, Monika K Varhadi1, Ajit S Bansode1, Suresh L Jadhav1, Nitin V Devhadrao2.Formulation, development and evaluation of Microsponge loaded Topical Gel of NystatinJournal of Drug Delivery & Therapeutics. 2019; 9(2-s):451-461

21. Arun Sharma, Rashmi Sareen, Varun Bhardwaj, Vineet Mehta. Topical gel incorporated with non- ionic surfactant based solid lipid microspheres of ketoprofen: Physicochemical analysis and anti- inflammatory evaluation. International Journal of Pharmacy and Pharmaceutical Sciences. 2015;7(10) :199-206.