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Formulation and Evaluation of Neem Drug Loaded Microsponges Gel for Topical Treatment of Antifungal Activity

Prof. Poonam Ankush Jadhav, Komal Hiraman Hake, Shambhuraje Manoj Dhumal, Kalyani Bhagwat Jadhav, Sheetal Rajesh Ghorad
PDEA Shankarrao Ursal Collage of Pharmaceutical Sciences and Research Centre, Kharadi, Pune

Abstract: *The purpose of present study aims to designs novel drug delivery system containing an antifungal drug and to prepare microsponge gel . Microsponge delivery system is unique technology for controlled release of active agents . As compare to conventional formulation, the microsponge gel is expected to remain on the skin for a longer time, gradually releasing drug over the time. Fungal infection is a common in these days , fungal infection occur when an individual fungus takes over an area of the body and is too much for the immune system to handle. Fungi can live in the air, soil, water, and plants. There are some fungi that live naturally in the human body . Prepared formulation was evaluated for pH, spreadability , viscosity, and ex-vivo drug deposition study.*

Keywords: Neem Extract , Microsponge, Antifungal drug , Microsponge gel, Topical delivery

I. INTRODUCTION

Microsponges are 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 .The particle size of microsponges are 5 to 300 Micrometer and Microporous beads, typically 10-25 microns in diameter , filled with an active agent, make up this one-of-a-kind technology for the controlled release of topical medicines. Drug release can be controlled by diffusion or a variety of other mechanisms when a microsponge delivery system is applied to the skin. Skin serves as an accessible and non-invasive route for drug delivery, boasting a large surface area with exposure to circulatory and lymphatic networks.
Main objective of microsponge is to minimizes drug dose and also minimizes side effects of drug and enhance the stability of formulation . They are also non-irritating and non- allergic in nature.

Ideal Characteristics of Microsponges :

1. Microsponges are typically spherical in shape .
2. They have a particle size range of 5 to 300 micrometer (um).
3. Microsponge are stable over the pH from 1.5to 11.
4. Microsponges are stable up to 130 c temperature.
5. Microsponges are compatible with many of active therapeutic material and excipients.
6. Approximately 38 to 62 % of drugs may entrapped in microsponge.
7. They are chemically stable ,ensuring the integrity of the entrapped substance .
8. They are generally non-toxic, non-irritating , non-mutagenic in nature .

Advantages of microsponges :

1. It increases the patient compliance.
2. Drug directly applies on target organs or area.
3. Drug loading capacity is higher than other topical preparations.
4. It can provide sustained or controlled release of active ingredient to reduce dose frequency .

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5. It can release drug at specific site , improving therapeutic effectiveness and minimize side effects .
6. It is biocompatible

Limitations :

1. Microsponge systems are generally not suitable for large molecules like proteins or peptides.
2. Formulation and production can be technically challenging and costly.
3. The polymer used in the microsponge may not be compatible with all active ingredients.
4. In some cases, the traces of residual monomers observed these are toxic and hazardous to health.

Gel : Gel is a semi solid formulation that has a pair of components which is liquid phase in rich. It has a character the continuous structure show like slid properties . Gels are as compare to the creams and other ointments give better drug release. These are highly bio-compatible minimum risk of adverse reaction and inflammation. The gels has many property as thixotropic, easily remove, non- greasy, desirable spreadable, non-staining, emollients, compatible with the many excipients. Topical drug delivery systems are applying as directly on the body surface as external part by spraying, rubbing, spreading. The topical rout of administration is very common and it is use as treatment of skin disorder and local effects . gel are widely used due to their ability to provide localized therapy , reduced systematic side effect and improve patient compliance .

Neem: : It is medicinal plant which has
Biological source of neem is Azadirachta indica
and Family of neem is Meliaceae . The chemical
constituents includes, limonoids like azadirachtin ,
nimbin and nimbidin flavonoids like Quercetin , kaempferol, phenols ,Tannins, saponins Alkaloids ,
carotenes etc.

Neem fresh leaves (Azadirachta indica)

Preformulation studies :

1. **Melting point determination:** The melting point of Neem leaf powder was found to be 259.23 degree.
2. **Solubility study**: The solubility of Neem leaf powder was determined by solvents such as alcohols, 0.1NHCl , water. Neem leaf powder is partially soluble in water and 0.1 N HCl, highly soluble in alcohols.

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3. **Determination of Ash value :**The total ash value of crude powder of Neem (Azadirachita Indica) by incineration 2gm of accurately weighed crude powder in a silica crucible . It was incinerated in muffle furnace at a temperature not exceeding until from carbon ,then cooled and weight and calculate total ash value .
4. **Determination of loss on drying** : The loss on drying was determined by weighing 2 gm of crude powder of Neem in an evaporating dish and then dried in an oven at 105^{o} C till constant weight was obtained and loss on drying was calculated .
5. **Determination of Extractive value** : Weight about 4 gm of coarsely powdered drug in a dried 250 ml conical flask and added 100ml solvent (water / alcohol) . cork the flask and set aside for 24 hr. filtered into 50ml cylinder . filtrate was collected . transffed 25 ml filtrate into porcelain dish. Evaporated to dryness on a water bath and complete the drying in an oven at 105^{o}C for 6 hr . cooled in a dessicator for 30 min. and weight immediately and calculate percentage w/w of extractive with reference to the air dried drug .

MATERIALS AND METHODS :

Materials: Azadirachta indica extract was obtained as a gift sample from Scientific F and Head of Office Botanical Survey of India Western Regional Center Pune (M.H.)411001 India. The reagents including carbopol 934 , triethanolamine , ethanol , methyl paraben , propyl paraben etc .

Methods:

- **Preparation of AZI microsponges :**

Quasi –Emulsion Solvent Diffusion (QESD) Method :

Step1 : The internal phase : ethyl cellulose (polymer) and drug (AZI) are dissolved with dichloromethane (organic solvent) .

Step2 : The External phase : Hydroxypropyl Methylcellulose (surfactant) is dissolved in water (aqueous solution).

Step3 : Emulsification : slowly added internal phase to the external phase under continuous stirring to form emulsion .

Step 4 : Solvent diffusion : The organic solvent diffuses into aqueous phase , leads to precipitation of the polymer.

Step 5 : Collection : It is done through evaporatation and filteration

Step6 : Drying : The microsponges is dried

Ingredients	**Formulations**								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Ethyl cellulose (gm)	0.5	1	1.5	0.5	1	1.5	0.5	1	1.5
Drug (gm)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dichloromethane (ml)	20	20	20	20	20	20	20	20	20
Hydroxypropylmethyl Cellulose K100 (gm)	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	0.75
Distilled water (ml)	100	100	100	100	100	100	100	100	100

Table 1: Composition of AZI loaded microsponges

Preparation of Gel Containing AZI Microsponges :

Carbopol 934P (1% w/v) was first soaked in water for two hours before being homogenously mixed with a magnetic stirrer at a speed of 600 rpm. Then, carbopol gel was evenly infused with AZI microsponges. To balance the pH, triethanolamine (2% v/v) was added. Propyl paraben and methyl paraben were added as preservatives.

Ingredient	**Formulation**								
Batches	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
Microsponges Drug (mg)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

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Carbapol 934 (gm)	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3
Methyl paraben (mg)	0.015	0.020	0.025	0.015	0.020	0.025	0.015	0.020	0.025
Propyl paraben (mg)	0.05	0.010	0.015	0.05	0.010	0.015	0.05	0.010	0.015
Triethanolamine (ml)	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s
Distilled water (ml)	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s

Table 2: Composition of Gel containing AZI microsponges

Evaluations of AZI loaded microsponges :

1. **Visual inspection :**The visual inspection of microsponges was determined by optical or binocular microscopy .
2. **Particle size analysis** : Particle size analysis of prepared microsponges was carried out by using An optical microscope to evaluate the average particle size of AZI loaded microsponge using a calibration ocular and stage micrometer under regular polarized light. The average particle size was obtained by measuring 20 particles of each batch using a little amount of microsponge dispersed on a clean glass slide and Particle size was determined.

$$\text{Average particle size} = \frac{\text{Diameter of particles in size range} \times 100}{\text{Total number of particle measured in that range}}$$

3. **Determination of production yield :**The production yield of the microsponges was determined by calculating accurately the initial weight of the raw materials and the final weight of the microsponges obtained.

$$\%\ \text{production yield} = \frac{\text{Practical mass of Microsponge} \times 100}{\text{Theorotical mass(polymer + Drug)}}$$

4. **Actual drug content and Entrapment efficacy** : The actual drug content was determined by the amount of drug which was entrapped in microsponges . The weighted amount of drug loaded microsponges was kept in 10 ml ethanol and soaked for 3hr . The sample samples were filtered and analyzed at

$$\text{Entrapment efficacy (\%)} = \frac{\text{Total amount of drug} - \text{Free unentrapped drug} \times 100}{\text{Total amount of drug}}$$

5. **Infra Red spectroscopy (IR)** : It was determined by Fourier transform infrared spectrophotometer (FTIR-410 , Jasco , Japan) using KBr pellet method . FTIR spectra of individual drug and excipient and microsponges formulation were recorded in the wavelength range of 3300 To 1300 cm^{-1}

Evaluation of Gel containing AZI loaded microsponges :

1. Visual inspection : The prepared gel formulation of microsponges was inspected visually for their color, texture and appearance .

2 pH measurement : The pH of gel formulation was determined by using digital pH meter. One gram of gel was dissolved in 100 ml distilled water and stored for two hours. The measurement of pH of the formulation was done .

3. .Spreadability studies : It is the term expressed to denote the extent of the area to which gel readily spreads on application to the skin or affected part. The therapeutic efficacy of a formulation also depends upon its spreading value. Spreadability is expressed in terms of time in seconds taken by two slides to slip off from gel placed in between the slides under the direction of certain load. Lesser the time is taken for separation of two slides, better the spreadability. Spreadability was determined by glass slides and a wooden block, which was provided by a pulley at one end. By this

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method, spreadability was measured on the basis of Slip and Drag characteristics of gels. A ground glass slide was fixed on this block. An excess of gel (about 1 gm) of different formulations was placed on the ground slide. The gel was then sandwiched between this slide and another glass slide having the dimension of fixed ground slide. Excess of the gel was scrapped off from the edges. The top plate was then subjected to pull of 20 gms, lesser the time is taken for separation of two slides better the spreadability.

Spreadability was then calculated using the following formula:

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

Where, S = is the spreadability

M = is the weight in the pan (tied to the upper slide)

L = is the length moved by the glass slide

T = represents the time taken to separate the slide completely from each other

4. Viscosity measurement : The viscosity of the different gel formulations was determined using a Brookfield viscometer with spindle no. 64 at 100 rpm at temperature 25˚C. The viscosity of the optimised formulation was determined as such without dilution using Brookfield Viscometer (Model-LVDV-E). Brookfield Viscometer consists of a cup, which is stationary and a spindle which is rotating. Different sized rotating spindles are used and immersed in the test material. For liquids with low viscosity, large size spindles (large diameter and surface area) are used while for higher viscosity liquids small spindles (small diameter and surface area) are used. Rotate the spindle in the microsponge gel t**ill** we get a constant dial reading on the display of the viscometer. This procedure is repeated three times for reproducible results

5. Drug content : 1 gm of AZI microsponge gel was accurately weighed and dissolved using methanol, sonicated for a period of 10-15 min and made up to the mark in 100 ml volumetric flask with methanol. From this 10 ml was pipetted out and diluted to 100 ml with methanol and the final dilution was made using distilled water to get a concentration within Beer's range. The absorbance was measured by UV spectrophotometer at 280 nm .against blank gel treated in the same manner as a sample.

6. In vitro drug release tests: Release of the Neem extract from microsponges incorporated in various gel formulations was measured through standard cellophane membrane using a Franz diffusion cell.Prior to study, cellophane membrane was soaked in diffusion medium for overnight, and then placed on the support screen of the diffusion cell assembly. Phosphate buffer pH 5.5 was used as the receptor medium and 1gm of the gel was placed on the donor side. All batches of Neem extract (F1-F9) were used for diffusion study. At predetermined time intervals, 2ml of sample was withdrawn from the receptor compartment and replaced with same volume of phosphate buffer pH 5.5. The aliquots were analyzed by UV spectrophotometer at 239.5 nm against PBS (pH 5.5). The graph of amount of drug diffused per unit area versus time was plotted and calculations were done by following formula:

1. Determination of concentration of drug diffused (ug / ml)

Slope and intercept were determined by using graph of absorbance versus concentration

$$Y = mx + c \quad \text{---} \quad \text{(Eq-5)}$$

Where, Y = Absorbance , m= Slope , x = Concentration , c = Intercept.

2. Cumulative amount of drug diffused (CADD):

[Concentration (ug / ml) x volume of diffusion medium Dilution factor } x1000 ---(Eq-6)

3. Surface area (A) of cellophane membrane (cm^2) :

$$A = \pi r^2 \quad \text{--- (Eq-7)}$$

4. Cumulative amount of drug diffused per unit area(CADD/cm^2):

$CADD/cm^2$ = CADD/Area of membrane --- (Eq - 8)

5. Flux (Jss):

Slope of linear portion of amount of drug diffused per unit area versus time.

6. Permeability Coefficient (Kp):

$$Kp = Jss / Cv \quad \text{--- (Eq-9)}$$

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6) Stability study:

The optimized gel formulation was subjected to a stability testing as per ICH guidelines at a temperature of 40+2'c and RH 75± 5%. Gel was filled in clean, lacquered aluminium collapsible tubes, and various replicates were kept in the humidity chamber maintained at 40°C and RH 75% 5%. The gel was analyzed for the change in appearance and pH at an interval of 7, 15, 30, days.

II. RESULT AND DISCUSSION

A. Collection of plant materials :

B. Authentication of plant materials :

The authentication of leaves was done from Scientific F and Head of Office Botanical Survey of India Western Regional Center Pune (M.H.)411001 India .It was confirmed that the procured leaves were of Azadirachta indica plant

C. Extraction of Azadirachta indica leaves:

The extraction was done by soxhlet extraction method .

Fig : Soxhlet extraction of leaves of plant and extract of leaves .

D. **Preformulation study**:

A) Characterization of Neem extract:

a. Organoleptic properties:

- Colour: Colour of the leaves was found to be dark green.

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- Odour: Odour of the leaves was found to be strong,pungent and bitter in nature.

b. Determination of pH: pH of the extract was found to be 6.3 while as per literature standard it is reported to be 5.5-6.5. As experimental values were in good agreement with official values, it could be concluded that procured extract was in pure form.

c. Phytochemical tests performed:

Table No. 4: Phytochemical tests

Sr.No.	Constituents	Tests	Procedure	observation
1	Alkaloid	1.wager's test	2-3 ml filtrate with few drops of wager's reagent gives reddish brown ppt	Present
		2.Hager's test	2-3 ml filtrate with hager's reagent gives yellow ppt .	Present
2	Flavonoids	1.shinoda test	This test was performed which showed formation of red coloration that indicated presence of Flavinoids.	Present
		2.sulphuric acid	On addition of sulphuric acid (66% or 80%) flavones and flavonols dissolve into it and give a deep yellow solution. Chalcones and aurones give red colour.	Present
3	Saponin	Foam test	Foam test- This test was performed which showed foam formation that indicated the presence of saponin.	present

D. Phytochemical test :

Characteristic property	Types	percentage
1. Ash value	• Total ash value	4.66 %
	• Acid insoluble ash value	2.42%
	• Water soluble ash value	1.071%
2. Extractive value	• Water soluble extractive value	12%
	• Alcohol soluble extractive value	16%
3. Loss on drying	---------	9.16%
4. Melting point	----------	259.23 ^{0}C

Identification of Neem extract:

1. **Ultraviolet spectroscopy**:

The ƛ max value of Neem extract was found to be 270.2 nm in Ethanol pH 7.3.This was in well compliance with the ƛ max value of Neem extract in literature.

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Fig no 4 : UV spectrum of neem extract in ethanol ph 7.5

Infrared spectroscopy :

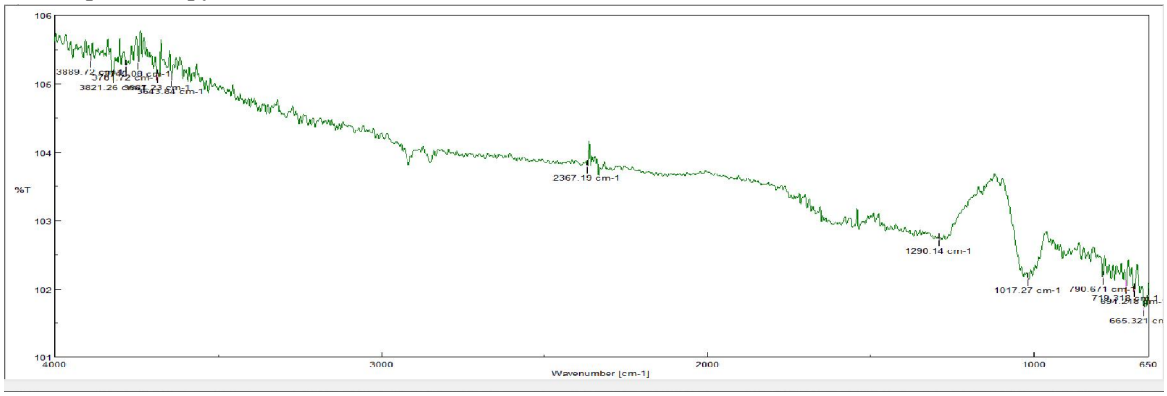

Table no: 4 **Wave no and functional groups of neem extract**

Sr.no	Wave number [cm^{-1}]	Range[cm^{-1}]	Functional group associated
1	3889.72	3000-3700	O-H (stretch)
2	3821.26	3000-3700	O-H (stretch)
3	2367.19	2100-2400	C ≡ N (stretch)
4	1290.14	900-1300	C-O (stretch)
5	1017.27	800-1200	C-C (stretch)

4. Drug Excipient Compatibility Studies

1. Visual observations:

No notable change was observed in the sample on visual observation. There was no observable color change.

2. Infrared spectroscopy:

FTIR spectrum of the mixture of Neem extract and excipients was compared with spectra of individual components. An FTIR spectrum of physical mixture shows significant peaks of Neem extract and respective excipient indicating no chemical interaction between Neem extract and excipient.

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A. FTIR (Drug + Ethyl cellulose)

Table no.7: *Drug + Ethyl cellulose*

Sr.No	Wavenumber (cm^{-1})	Range (cm^{-1})	Functional groups associated
1	3695.91	3000-3700	O-H (stretch)
2.	2971.77	2700-3300	C-H (stretch)
3.	2843.52	3000-25000	C-H (stretch)
4.	2075.03	2100-2400	C ≡ N (stretch)
5.	1698.02	1600-1700	C-N (stretch)

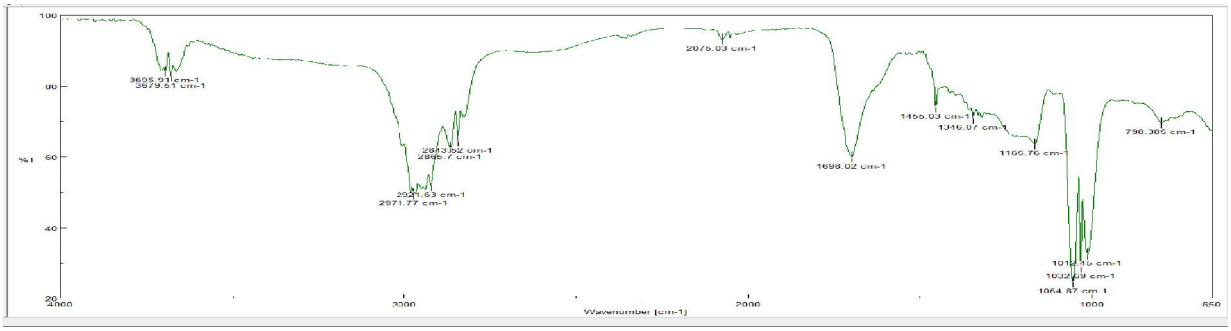
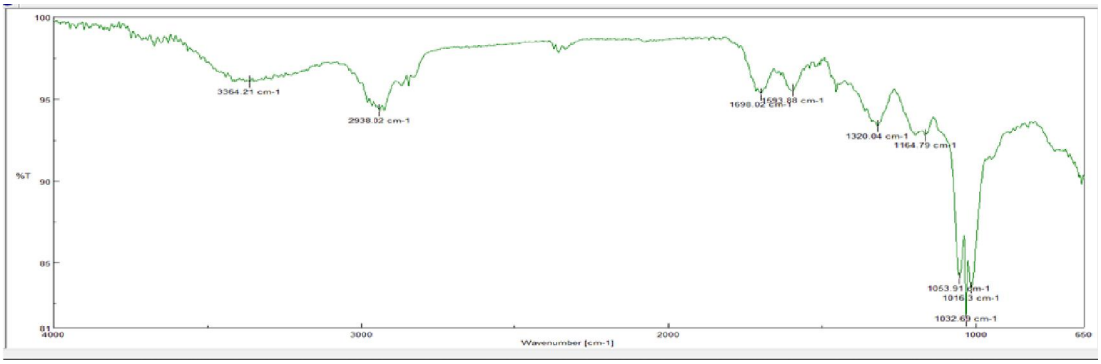


Table no 8: Drug + HPMC K100

Sr.no	Wave number (cm^{-1})	Range (cm^{-1})	Functional group associated
1	3364.21	3300-3600	C=O (Stretch) 2v
2	2938.02	2700-3300	C-H (Stretch)
3	1698.02	1600-1700	C-C(Stretch)
4	1320.04	1200-1500	O-H (Bending)
5	1032.69	800-1200	C-C(Stretch)



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C . Drug+ Carbopol 934:

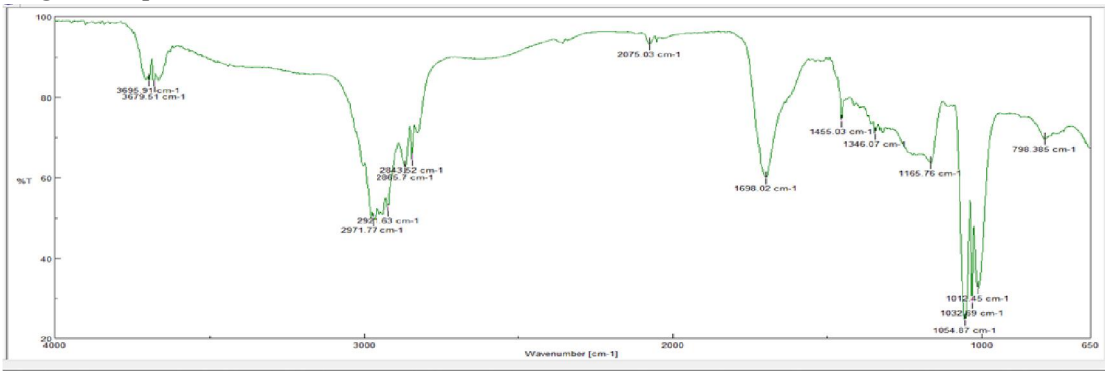

Table no 9: Drug + Carbopol

Sr.no	Wave number (cm^{-1})	Range (cm^{-1})	Functional group associated
1	3695.91	3000-3700	O-H (Stretch)
2	3679.51	3000-3700	O-H (Stretch)
3	2971.77	2700-3300	C-H (Stretch)
4	1698.02	1600-1700	C-C (Stretch)
5	1165.76	800-1200	C-C (Stretch)

Evauation of Neem extract Microsponges:

1. Determination of production yield ,Entrapment Efficiency and Actual Drug content of Neem extract

Batch	Amount of ethyl cellulose (gm)	Amount of HPMC (gm)	Theoratical Yield (gm)	Practical Yield (gm)	Production Yield (%)	Entrapment Efficiency (%)	Actual Drug content (%)
F1	0.5	0.25	1.25	0.42	33.6	33.6	33.6
F2	1.0	0.25	1.75	1.30	74.2	33.14	33.14
F3	1.5	0.25	2.25	1.28	56.8	57.78	57.78
F4	0.5	0.50	1.5	0.46	30.6	51.2	51.2
F5	1.0	0.50	2.0	0.8	40	23.0	23.0
F6	1.5	0.50	2.5	1.24	49.6	21.4	21.4
F7	0.5	0.75	1.75	0.46	26.28	55.11	55.11
F8	1.0	0.75	2.25	0.66	29.33	32.0	32.0
F9	1.5	0.75	2.75	1.26	45.8	45.82	45.82

The % production yield of all batches was ranged from 26.00% to 75.0%, it was found that the production yield was greatly affected by polymer concentration as well as by concentration of ethanol

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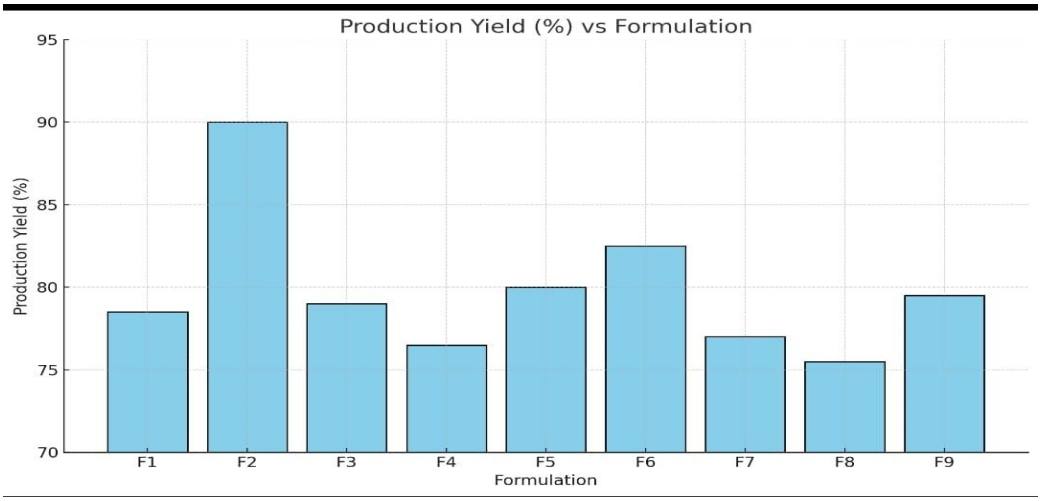

Fig no- 6:percent production yield of Microsponges

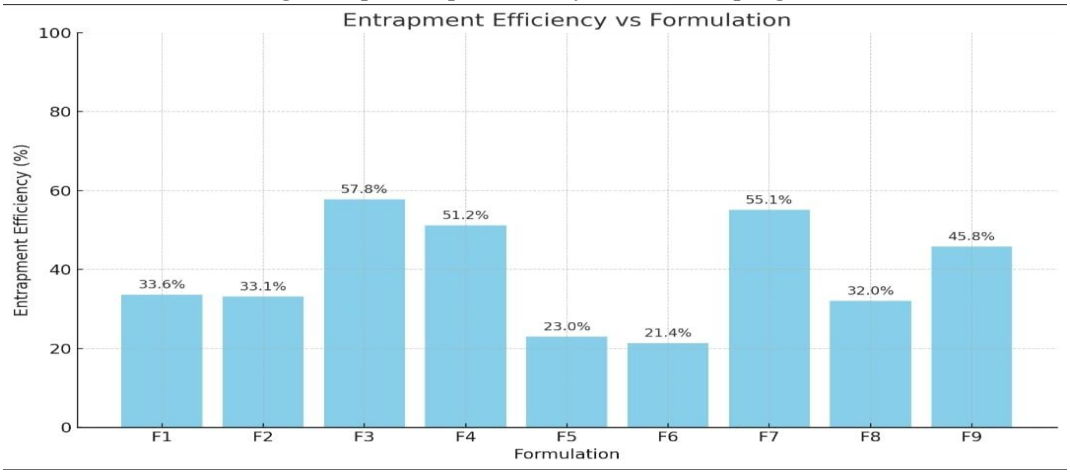

Fig no 7:Percent Entrapment Efficiency of Microsponges

3.Particle size Anaysis:

Particle size of Microosponges should be in the range of 5 - 500nm visual inspection of all batches for particle size using optical and binocular microscope revealed that the particle size was increased with the increase in the Ethyl cellulose amount. This might be due to increasing polymer wall thickness which led to the larger size of Microsponges. The F2 batch possessed more percent of intact, uniform, spherical particles in optical microscopy; so the batch F2 was chosen for further analysis. A mean particle size of formulation F2 was found to be 100 nm.

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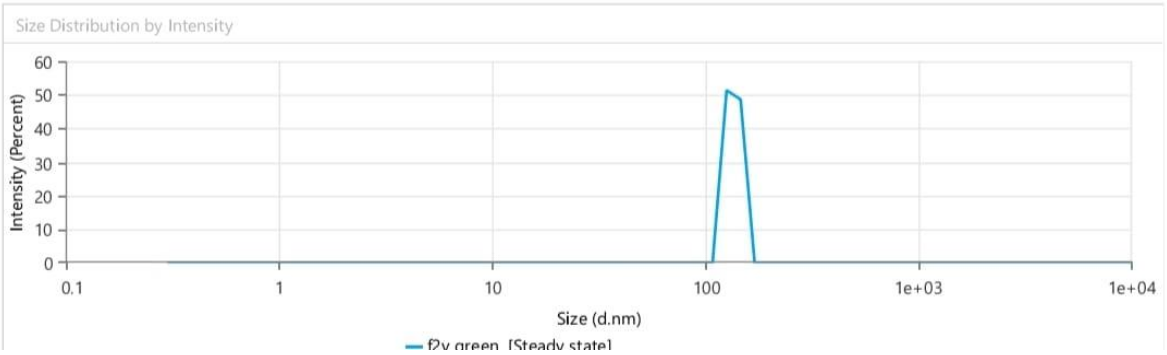

Fig no .8- Particle Size of Microsponges

4. Differential scanning calorimetry (DSC):

DSC performed in order to access the thermal properties and thermal behaviour of the drug and the extract. It measures the heat flow in out of both sample and references during a controlled temperature programme .the nature of the drug and its thermal behaviour was studied by differential scanning calorimetry (DSC) .About 5mg of the sample was sealed in aluminium pan and heated at the rate 10°c/min, covering a temperature range of 40°C to 300°C under nitrogen atmosphere of flow rate 10ml/min and DSC Thermogram for pure drug and extract was obtained

Evaluation of Neem extract Microsponges gel :

1.Physical appearance :

The prepared gel formulations of Neem leaves extract Microsponges were visually inspected for their colour, consistency and odour. Physical appearance of gel is as shown table:

- Colour : Pale green
- Consistency **:** Good
- Odour : Aromatic

2. **Determination of pH:** From table it was found that the pH of all prepared formulation ranged between 5.23±0.1193 to 5.67±0.01155.

Table No. 11: pH of all formulations

Batches	pH 1	2	3	Std Deviation
F1	4.57	4.56	4.58	4.50±4.61
F2	4.72	4.64	4.66	4.62±4.73
F3	4.8	4.78	4.8	4.74±4.85
F4	4.94	4.87	4.92	4.86±4.97
F5	5.01	5.05	4.98	4.98±5.09
F6	5.1	5.3	5.1	5.10±5.21
F7	5.31	5.2	5.31	5.22±5.33
F8	5.44	5.41	5.42	5.34±5.45
F9	5.48	5.5	5.47	5.46±5.50

3.Spreadability of drug content : The values of spredability of all prepared formulation were found to be in the range of 3.00±1.08 to 50.00±2.62 g.cm/sec and drug content ranges from 81.1 to 92.5. Hence, it indicates that spredability and drug content of gel was good.

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Batches	Mass(gm)	Length(cm)	Time(sec)	Spreadability(gm.cm/sec)
F1	10	9	12.66	7.114
F2	10	11.5	2.35	48.936
F3	10	10.5	1.70	61.764
F4	10	9	12.60	7.142
F5	10	8.5	1.10	77.27
F6	10	9.3	5.40	17.22
F7	10	8.8	13.51	6.5136
F8	10	9.4	29.26	3.212
F9	10	8.6	15.95	9.391

4.In vitro drug release studies : In vitro drug release study was carried out using phosphate buffer pH 7.4 using Franz diffusion cell.It is given the following table:

Sr no	Time(min)	Absorbance	Concentration (mg/ml)
1	0	0	0
2	30	0.127	1.83
3	60	0.148	2.87
4	90	0.17	3.96
5	120	0.202	5.54
6	150	0.218	6.34
7	180	0.22	6.44

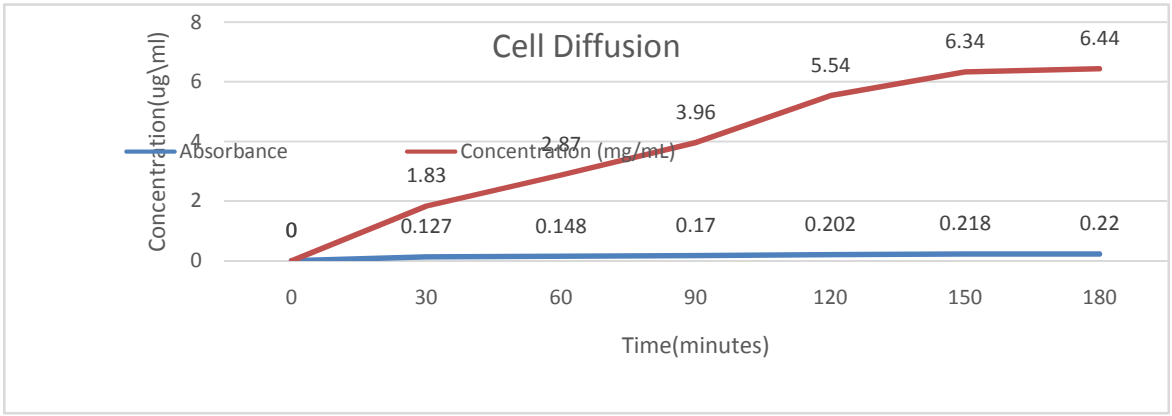

Fig No 8-In vitro diffusion study of Formulation

5. Stability study:

The stability studies of formulated gel were carried out at room temperature for one month. The effect of temperature, humidity and time on the physical characteristics of the gel was for assessing the stability of the prepared formulations. The stability studies were carried out when the room temperature was 25" C. The Results were shown in Table no. 9Therefore no

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evidence of degradation of drug was observed.

Table No 12: Appearance ,pH and Homogeneity of Formulation

Time interval (Days)	Appearance	pH	Homogeneity
0	Pale green	4.4	Very good
7	Pale green	4.5	Very good
15	Pale green	5.0	Good
30	Pale green	5.0	Good

Summary and conclusion :

The integration of neem extract into Microsponge-based gel formulations presents a promising advancement in the realm of topical drug delivery and cosmeceutical applications. Microsponge technology not only facilitates the sustained and controlled release of neem's bioactive compounds but also enhances their stability and skin compatibility. This targeted delivery system can significantly reduce the adverse effects commonly associated with direct neem application, such as irritation or hypersensitivity, thereby improving patient compliance and therapeutic outcomes.

Looking forward, neem-loaded microsponge gels hold immense potential in the treatment of various dermatological disorders, including acne vulgaris, eczema, and fungal infections. Additionally, their incorporation into cosmetic formulations aligns with the increasing global demand for natural, sustainable, and efficacious skincare solutions. Future research should focus on optimizing the microsponge matrix for improved drug loading, evaluating long-term stability, and conducting comprehensive clinical trials to validate efficacy and safety.

With ongoing innovation and scientific validation, microsponge-containing neem gels are poised to emerge as a significant development in both pharmaceutical and cosmeceutical industries, bridging traditional herbal medicine with modern delivery technologies.

Future Perspective:

A Microsponge consists of a myriad of interconnecting voids with in non-collapsible structure that can accept a wide variety of substance. The outer surface is typically porous allowing the flow of substance into and out of the sphere, scientist are more concentrating on delivery of anti-acne, sunscreen, antidandruff, agents which can also use in delivery of thermo labile substance such as vaccines, proteins, peptides, and DNA based therapeutics, now-a-days, it is also used in tissue engineering and in controlled drug delivery for therapeutic agents, which requires long duration of therapy Optimization techniques are carried out in these studies to get best out come from various formulation. Hence it requires lot of skills for developing novel formulation for the tropical diseases. Some Microsponges based products are already approved; several others are currently under development and clinical assessment.

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