IJPSR (2014), Vol. 5, Issue 4 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 29 October, 2013; received in revised form, 19 December, 2013; accepted, 10 March, 2014; published 01 April, 2014

DEVELOPMENT AND EVALUATION OF SOME MICROSPONGE LOADED MEDICATED TOPICAL FORMULATIONS OF ACYCLOVIR

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Keywords:

Acyclovir, Microsponge, Herpes, Herbal Gel, Medicated Lipstick

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ABSTRACT: Skin has to bear various external traumas like wounds, burns, blisters, irritation *etc*. as well as topical diseases *like psoriasis, vitilago, cancer and herpes*. Various drug delivery systems like vesicles, microspheres, transdermal patches, nanoemulsions, microemulsions, microsponges *etc*. are available which are better than conventional drug delivery methods because these bypass systemic circulation as well as drug can be targeted directly to the required site. Microsponges are tiny sponge-like spherical particles with a large porous surface and provide controlled release. *Herpes simplex* is a viral disease occurring in two forms *Herpes labialis* and *Herpes keratitis* which occur on lips and epidermal layer of skin respectively. Conventional formulations used for treating herpes have various drawbacks like irritation, rashes, frequency of dosing and low bioavailability. Hence microsponge loaded topical preparations herbal gel and medicated lipstick of Acyclovir was prepared with a purpose to overcome these drawbacks. Microsponge loaded controlled release formulations of Acyclovir were prepared using *quasi emulsion solvent diffusion* method. The proposed formulations of Acyclovir loaded microsponges were characterized for particle size, production yield and entrapment efficiency. The range of production yield was found to be between 57.43 % and 77.81 %, entrapment efficiency was found to be between 68.95 % and 87.56% and particle size was found between 376.3 nanometers to 777.7 nanometers for different batches. Porous structure of microsponges was confirmed by Scanning Electron Microscopy. After evaluation best optimized batch was incorporated in carbopol and aloe gel and lipstick base. Microsponge loaded herbal gel and lipstick were evaluated for various physical parameters. *In- vitro* release studies using diffusion cell revealed that the drug release followed Korsemeyer Peppas model.

INTRODUCTION: The Microsponge Delivery System (MDS) is a unique technology for the controlled release of topical agents.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.5(4).1395-10

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.5(4).1395-10

These are polymeric delivery systems composed of porous microspheres of an inert polymer that can entrap active ingredients and control their delivery rate.

The microsponges behave like a reservoir of the active ingredients. These can potentially be used for the controlled delivery of a large variety of substances such as fragrances, emollients,

sunscreens, anti-inflammatory, antifungal, anti-microbial agents.

The outer surface is porous, allowing the sustained flow of substances out of the sphere. Microsponge delivery system (MDS) can provide increased efficacy for topically active agents with enhanced safety, extended product stability, enhanced formulation flexibility, reduced side effects and improved aesthetic properties in an efficient and novel manner. In addition these are non-irritating, non-mutagenic, non-allergenic, and non-toxic [6, 7, 8, 9, 10].

Acyclovir (ACV), a guanine analogue, is a first-line antiviral drug for the treatment of infections caused by the herpes viruses. The main drawbacks of currently available topical ACV creams are that they render evaporation of active ingredient from surface of skin, dry, cracked, or peeling lips, Dryness or flaking of treated skin, irritation, burning, stinging and itching [13, 15].

The aim of the present work was to develop a therapeutically effective topical delivery system, which is expected to overcome all these drawbacks.

A number of herbs are found to cure or help in the cure of *Herpes*. These herbs are: *Aloe vera, Melissa officinalis*, peppermint oil, tea tree oil, sandalwood. Therefore, the most prevalently reported herbs have been identified to be a part of the novel topical herbal formulation(s) of MDDS loaded Acyclovir [12].

Aloe vera is supposed to help in treatment of herpes by stimulating body's own immune response which is effective against herpes. Polysaccharides in Aloe stimulate white blood cell activity and increase the number of T-helper cells. These cells coordinate the immune response, resulting in the production of antibodies and ridding the body of the infectious agent.

Studies have also shown that an Anthroquinine called Emodin in Aloe Vera disables the functioning of herpes simplex virus type 1 and 2. Also it keeps the skin hydrated and reduces irritation in herpes [11, 12].

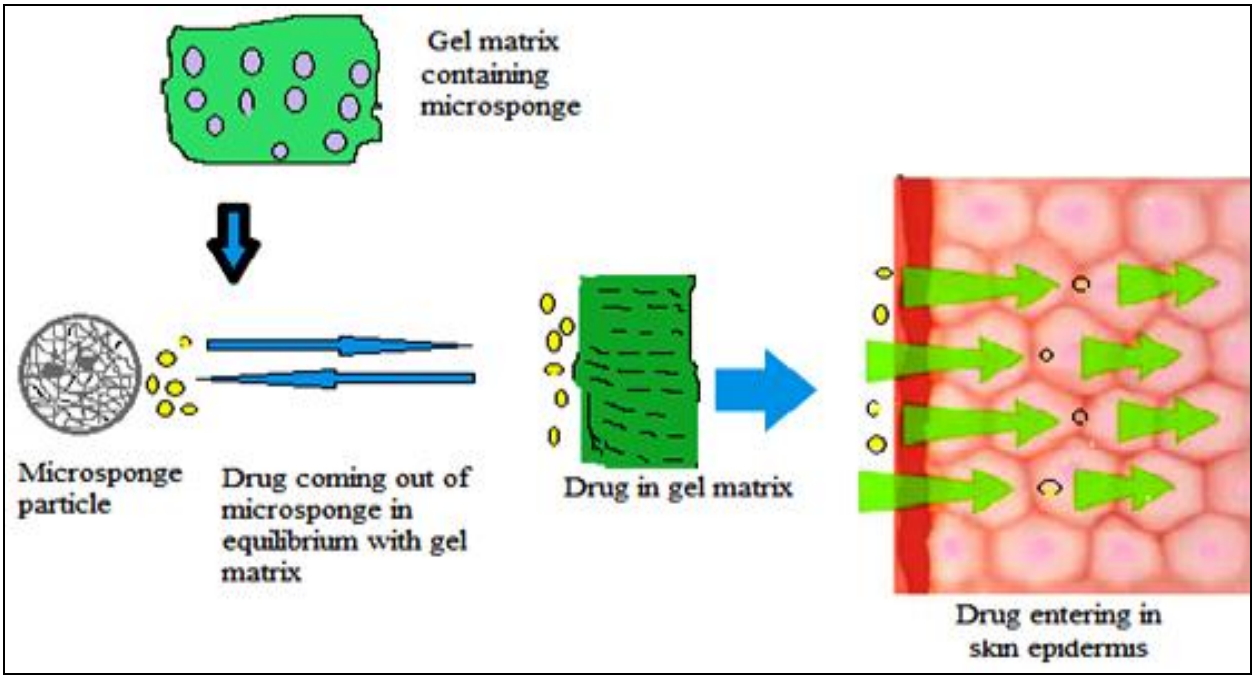


FIG. 1: RELEASE MECHANISM OF DRUG FROM MICROSPONGE

MATERIALS AND METHODS: Materials used: Poly vinyl alcohol was used for making external phase, ethyl cellulose for making internal phase. Solvents used are dichloromethane, ethyl alcohol, distilled water and as plasticizer triethyl citrate was used.

Method:

Preparation of the Microsponges: Microsponges were prepared by quasi-emulsion solvent diffusion

method using 2^2 factorial design as shown in **table 2**. PVA was weighed and added to distilled warm water and agitated to fully dissolve PVA in water and hence external phase was prepared.

The ethyl cellulose was weighed and dissolved in dichloromethane and then drug was added to it and internal phase was prepared. Internal phase was added to external phase drop-wise during addition and after addition stirring was done with help of mechanical stirrer at rate of 1000- 1500 rpm for 2 hrs to evaporate Ethyl alcohol. The microsponges were collected by filtration and dried in oven at 40ºC for 24 hours. The dried microsponges were stored in vacuum desiccators to ensure the removal of residual content [1, 2, 6, 7, 8, 9, 10].

TABLE 1: OPTIMUM VALUES FOR MICROSPONGE FORMULATION

Specifications	Optimum Value
Drug: Polymer ratio	1:1,2:3
Amount of drug (mg)	200
PVA (mg)	150 -300
Inner phase solvent	Ethyl alcohol
Amount of inner phase solvent(ml)	20
Amount of water in outer phase(ml)	150
Temperature of inner phase (°C)	37
Stirrer Type	Three Blade
Stirring rate	500-1000
Stirring time(min)	120

TABLE 2: FORMULATION OF MICROSPONGES

Batch	X_1	X_2
F1	+1(150)	-1(100)
F2	+1(150)	+1(150)
F3	-1(100)	+1(150)
F4	-1(100)	-1(100)

X_1, amount of polyvinyl alcohol (mg); X_2, amount of Ethyl cellulose (mg). The values in brackets represent real values.

TABLE 3: FORMULATION OF MICROSPONGES

S. No.	Formulation code	Acyclovir sodium (mg)	Polyvinyl alcohol (mg)	Ethyl cellulose (mg)	Dichloro methane (mL)	Distilled water (mL)
1	F1	100	150	100	20	150
2	F2	100	150	150	20	150
3	F3	100	100	150	20	150
4	F4	100	100	100	20	150

Characterization of Microsponges [1, 2, 3, 5]: Various evaluation tests were performed to evaluate the prepared formulations of microsponges.

1. **Percentage Yield:** The prepared microsponges of all batches were accurately weighed. The percentage yield of microsponges was calculated by using following equation:

% Yield =

$$\frac{\text{Actual weight of product}}{\text{Total weight of product}} \times 100$$

Fig. 1 shows % yield of microsponges and table 4 shows various evaluation parameters of microsponges.

2. **Drug Loading and Drug Entrapment:** Microsponges equivalent to 100 mg of the drug were taken for evaluation in a mortar and pestle and little amount of phosphate buffer pH 6.8 was added and allowed to stand for 24 hours. The contents were then transferred to 100 ml volumetric flask and volume was made up to 100 ml with phosphate buffer of pH 6.8. The solution was filtered through Whatmanns filter paper. From the resulting solution 1 ml solution was taken to 100 ml volumetric flask and volume was made up to 100 ml with phosphate buffer of pH 6.8. Drug content was determined by UV spectrophotometer at 253nm. The entrapment was calculated by using following formula:

The actual drug content (%) = (W*act* / W*ms*) x 100

Entrapment efficiency = (W*act* /W*the*) x 100

Where;

W*act* is the actual Acyclovir content in the weighed quantity of the microsponge

W*ms* is the weighed quantity of powder of microsponges, and

W*the* is the theoretical amount of Acyclovir in microsponge calculated from the quantity added during preparation. **Figure 2** shows drug entrapment/loading efficiency of various formulations of microsponges.

3. **Particle Size Determination:** Determination of particle size of Acyclovir loaded microsponges was done by using Zeta Sizer Instrument (Malvern, UK) equipped with Hydro dispersing unit. Particle sizing experiments were carried out by means of laser light diffractometry. **Fig. 3** shows particle size analysis of microsponge formulations.

4. **Scanning Electron Microscopy:** The shape and surface characteristics of microsponges were analyzed using Scanning Electron Microscope CPN NIPER, Mohali, Punjab. SEM images of Acyclovir loaded microsponges are shown in **Fig. 4 and 5**.

5. **Differential Scanning Calorimetric Studies:** Thermal analysis of Acyclovir, ethyl cellulose, PVA and physical mixture of Acyclovir, ethyl cellulose, PVA and Acyclovir loaded microsponges (F2) were scanned at a rate of 10ºC / min on a Shimadzu TA Instruments 010-0436 Q Series in dynamic nitrogen atmosphere. The DSC thermo grams were recorded as shown in **Fig. 6, 7, 8 and 9** respectively.

6. **FTIR Studies:** Infrared absorption spectroscopy (IR) of Acyclovir, ethyl cellulose, Physical mixture of both and microsponge formulation of Acyclovir and ethyl cellulose were recorded using a FTIR Alpha, Bluker Spectrometer as shown in **Fig. 10, 11 and 12**.

7. ***In vitro* Drug Release Studies:** The release of Acyclovir from microsponge was investigated in pH 6.8 phosphate buffer as a dissolution medium (900 ml) using USP (type I) apparatus. A sample of microsponge equivalent to 100 mg of Acyclovir was taken in the basket. A speed of 100 rpm and temperature of 37 ± 0.50ºC was maintained throughout the experiment. At fixed intervals, aliquots (10 ml) were withdrawn and replaced with fresh dissolution media. Each batch was run 3 times. The mean of the three readings was taken. The concentration of drug released at different time intervals was then determined by measuring the absorbance using Hitachi U-2000 spectrophotometer at 274 nm against blank. Release profile of microsponges is shown in **table 6**.

TABLE 5 PROCESS PARAMETERS FOR *IN VITRO* STUDIES

Parameter	Conditions
Apparatus	USP Type 1(Lab India DS 8000)
Dissolution Medium	Phosphate buffer pH 6.8
Temperature	37ºC (±0.5)
RPM	100
Volume of sample	10 ml
Volume of buffer	900ml
Amount of microsponges	Microsponge Powder equivalent to 20 mg of drug

Determination of cumulative % released:

% cumulative released = (Cc/Cmax) × 100

$\mathbf{C_{max}}$ = Total concentration of drug in sampled microsponges.

% cumulative released was plotted against time with each representing mean ± S.D. OF triplicate. Table 6 shows *in vitro* dissolution data.

Fig. 13 shows Comparative *in vitro* release study of batches of microsponges.

TABLE 6: *IN VITRO* DISSOLUTION DATA

Time	f1	f2	f3	f4	SD	RSD (%)
30	12.30%	13.60%	13.40%	12.10%	0.0076	5.91
60	22.10%	24.50%	22.90%	21.80%	0.0121	5.30
120	32.80%	35.70%	35.50%	33.90%	0.0138	3.99
180	39.30%	41.60%	41.80%	38.80%	0.0155	3.83
240	45.70%	48.90%	50.30%	44.70%	0.0264	5.56
300	56.10%	58.90%	57.20%	54.60%	0.0181	3.20
360	63.30%	65.50%	64.70%	61.70%	0.0167	2.62
420	67.10%	69.80%	71.20%	68.20%	0.0180	2.60
480	69.20%	72.60%	75.40%	71.30%	0.0259	3.60
540	73.40%	78.30%	79.10%	75.10%	0.0268	3.51
600	79.80%	83.70%	86.10%	81.30%	0.0276	3.34

F1, f2, f3, f4 are 4 different batches of microsponges. SD: Standard deviation, RSD: Relative standard deviation.

Formulation of microsponge loaded herbal gel of Acyclovir: Carbopol was accurately weighed and dissolved in 10 ml of distilled water and left for 2 hrs to swell and form gel. Solvent blend of methanol: PEG 400 which contain microsponges equivalent to 100 mg of Acyclovir and Aloe gel were added to carbopol gel with constant stirring. To the whole mixture added triethanolamine dropwise until transparent gel was obtained. Stirring was stopped to escape entrapped air, Further formed gel was stored in air tight container for further study. Table no. 7 shows formulation of herbal gel of Acyclovir.

TABLE 7: FORMULATION OF HERBAL GEL OF ACYCLOVIR LOADED MICROSPONGES

Sr. no.	Ingredient	Quantity
1.	Microsponges equivalent to 250 mg of Acyclovir	5%
2.	Carbopol	1.5 %
3.	Distilled water	100 ml
4.	Methanol	5 ml
5.	Polyethylene glycol	6 drops
6.	Aloe gel	2.5 gm
7.	Triethanolamine	5 ml

Evaluation of Acyclovir Loaded herbal microsponge gel [16]:

1. Spreadability
2. pH
3. Consistency
4. Homogeneity
5. Drug release by *in vitro* diffusion studies

1. **Spreadability:** Spreadability was determined by wooden block and glass slide apparatus. It consists of two slides upper movable slide and lower non- movable slide. Weights about 20gm were added to the pan and time was noted for upper slide to separate completely from the fixed slides. Spreadability was then calculated by using the formula:

$$S = M.L / T$$

Where, S = Spreadability; W= Weight tide to upper slide; L = Length of glass slid; T = Time taken to separate the slide completely from each other

2. **pH** The pH of the gel was determined by using labtech digital pH meter.

3. **Consistency:** The measurement of consistency of the prepared gels was done by dropping a cone attached to a holding rod from a fix distance of 10cm in such way that it should fall on the center of the glass cup filled with the gel. The penetration by the cone was measured from the surface of the gel to the tip of the cone inside the gel. The distance traveled by cone was noted down after 60sec.

4. **Homogeneity:** Developed gel was tested for homogeneity by visual inspection after the gel has been set in the container. The gel was tested for its appearance and presence of any aggregates. **Table 8** shows values of various parameters of gel.

TABLE 8: VALUES OF VARIOUS PARAMETERS OF GEL

Batch No.	pH	Spreadability (g.cm/sec)	Homogeneity	Consistency (60 sec)
1.	6.8	6.0	Good	10 mm

Drug release by *in vitro* studies: *In vitro* diffusion study of gel containing Acyclovir microsponge was carried out for 10 hrs, the total amount of drug release was observed at different time intervals for a period of 10 hrs. Phosphate buffer of pH 6.8 was used as receptor medium. Cellophane membrane previously soaked overnight in the dissolution medium was used in modified Franz Diffusion Cell. The gel sample equivalent to 100mg microsponge was applied on cellophane membrane and then fixed in between donor and receptor compartment of diffusion cell. The receptor compartment contained phosphate buffer (100ml) of pH 6.8. The temperature of diffusion medium was thermostatically controlled at 37ºC ± 1ºC by surrounding water in jacket and the medium was stirred by magnetic stirrer at 100rpm. The sample at predetermined intervals were withdrawn and replaced by equal volume of fresh fluid. The samples withdrawn were spectrophotometrically estimated at 256 nm using phosphate buffer (pH

6.8) as blank. Figure 18 shows drug release profile of Acyclovir loaded microsponge gel. **Table 9** shows % drug release from microsponge gel.

TABLE 9 % DRUG RELEASE FROM MICROSPONGE GEL

Time (min.)	% Drug release
30	10.4
60	15.6
120	19.3
180	28.8
240	37.9
300	46.7
360	56.3
420	64.8
480	70.2
540	77.3
600	85.7

Preparation and evaluation of microsponge loaded lip stick: Medicated cosmetics can be used to cure skin problems by achieving esthetic sense. Microsponge loaded lip balm is prepared to cure *herpes labialis i.e*. a form of *herpes* that occurs on and around lips.

Preparation of Lipstick base:

TABLE 9: FORMULA USED FOR PREPARATION OF LIPSTICK BASE

Ingredients	Quantity %
Bees wax	5%
Paraffin wax	12%
Cetyl alcohol	15%
Castor oil	35%
Cetosteryl alcohol	5%
Lanolin	18%
Microsponge	Equivalent to 5% of Acyclovir
Propyl Paraben	0.05%
Light liquid paraffin	5%

All the ingredients were weighed and melted in hot water bath in descending order of their melting point and continuously stirred with glass rod. Color lake was triturated and dissolved in castor oil and added to the mixture of melted waxes. At the end microsponges were added with continuous stirring. Molten mass was poured to clean and prelubricated lipstick moulds and chilled to achieve contraction of the waxes to facilitate easy removal of the stick.

Evaluation of lipstick:

1. Melting point
2. Softening point
3. Breaking load test
4. Stability studies

1. **Melting point:** Lipstick sample of 50 mg was taken. This was melted and filled into a glass capillary tube open on both the ends. This capillary tube was cooled in ice for about 2 hours and attached to a thermometer. This assembly was dipped into a beaker full of water and was heated with continuous stirring. The temperature at which the material moves through capillary tube was considered its melting point.

2. **Softening point (ring and ball method):** The lipstick sample was inserted into an aluminum ring. Extra mass above and below the orifice was removed using a sharp blade to get a lipstick tablet into the ring. This was placed in a refrigerator (60ºC) for 10 mins. After removing it from the refrigerator, the ring was fastened onto a stand and a steel ball was delicately placed on the lipstick tablet. This assembly was dipped into a beaker full of water. Temperature was monitored using a thermometer. Softening point was the temperature at which both the lipstick mass and the steel ball were loosened and fell to the bottom of the beaker.

3. **Breaking load test:** The protruded lipstick salve was subjected to a number of weights hanging from it. The weight at which the lipstick broke was its breaking load.

4. **Stability studies:** The lipsticks were placed for stability studies at temperature 4ºC (in refrigerator), 20-25ºC (at room temperature), 30-40ºC (in oven) and were observed for effects like sweating ,bleeding, streaking, blooming.

Table 10 shows values of various evaluation parameters of lipstick.

TABLE 10: EVALUATION OF LIPSTICK

Name of test	Value
Melting point	65ºC
Softening point	56ºC
Breaking load	276. 50 gm
Stability studies	No signs of sweating, blooming, bleeding or streaking

RESULTS AND DISCUSSIONS: Percentage yield, loading efficiency and particle size of four

batches of microsponges are shown in **table 4** and **figure 2, 3 and 4** show their respective representation in graphical form.

Results of compatibility studies show that no interaction was found between drug and excipients which were confirmed by DSC studies and FT-IR spectra. The DSC thermo grams were recorded as shown in **Figure 7, 8, 9 and 10** respectively.

FTIR Spectra of Acyclovir: FTIR Spectra of Acyclovir was recorded using FTIR Alpha, Bluker, Germany instrument. The IR spectrum of pure drug in figure shows the characteristic sharp peak at 3522 cm^{-1} and broad peak at 1388 cm^{-1} for O-H, stretch at 3441cm^{-1} and bend at 1620 cm^{-1} for N-H, at 1215cm^{-1} for C-N, at 1693cm^{-1} for C=N ,at 752 cm^{-} for out of plane C-H bending, 1485 cm^{-} for C ¨ N stretch, at 1715cm^{-1} for aromatic ketone and at 1184 cm^{-1} for ethoxy group.

On studying various spectra shown in **figure 11, 12 and 13** the results suggested drug stability during the encapsulation process. SEM images of Acyclovir loaded microsponges are shown in **fig. 5 and 6**.

TABLE 4: EVALUATION PARAMETERS OF MICROSPONGES

Batch	PVA	Ethyl Cellulose	Weight of excipients and drug (mg)	Weight of microsponges (mg)	% Yield	Loading efficiency	Particle size (µm)
F1	150	100	350	201.00	57.43%	71.5%	.4608
F2	150	150	400	279.04	69.76%	87.56%	.4366
F3	100	150	350	272.34	77.81%	68.95%	.3763
F4	100	100	300	190.32	63.44%	70.90%	.7777

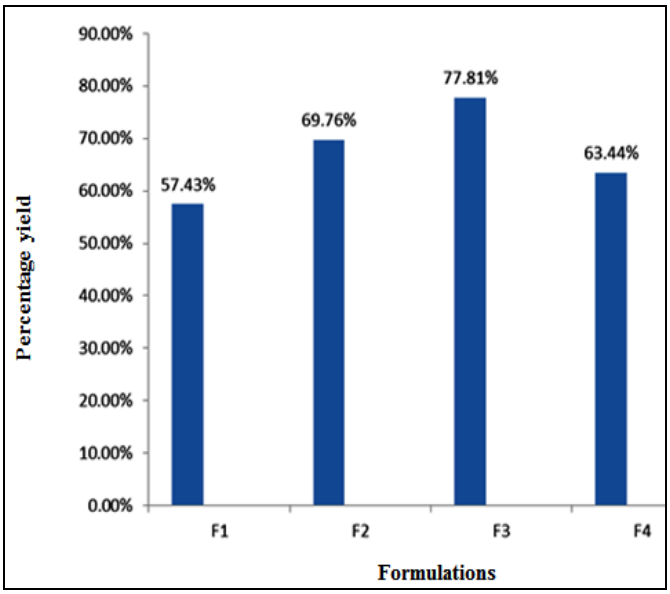


FIG. 2: % YIELD OF MICROSPONGE

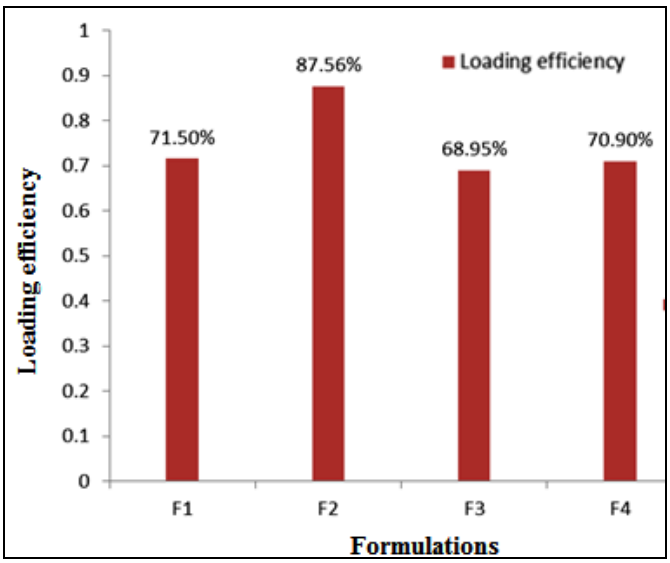


FIG. 3: LOADING EFFICIENCY

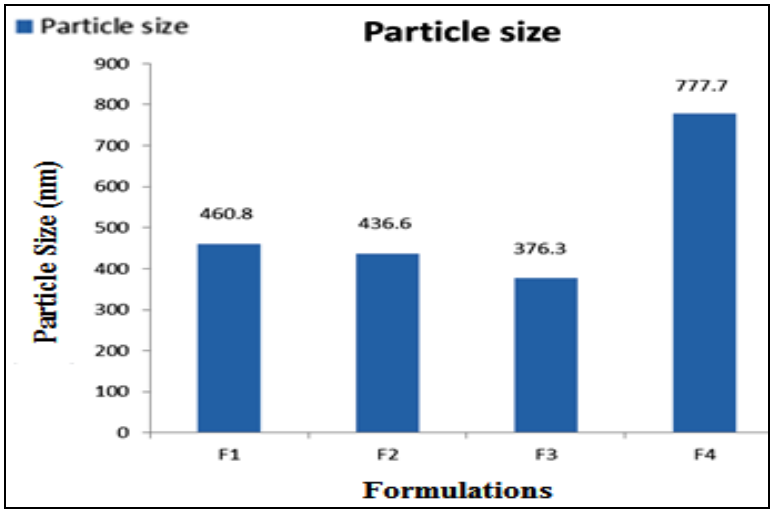


FIG. 4: PARTICLE SIZE ANALYSIS OF MICRO-SPONGE FORMULATIONS

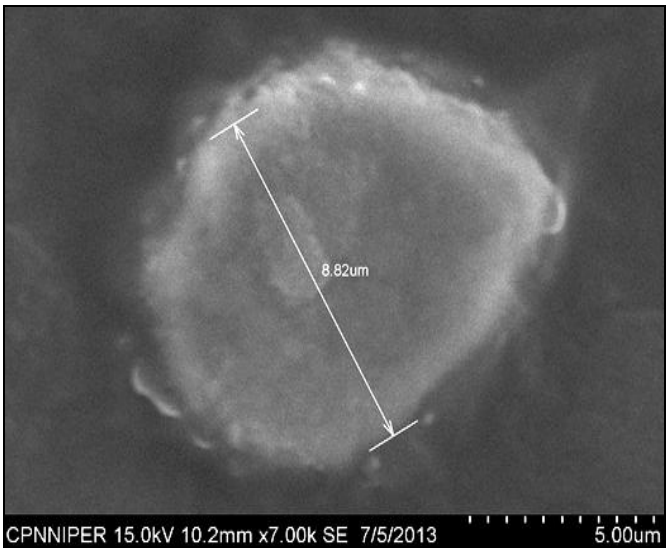


FIG. 5: SEM PHOTOGRAPH OF ACYCLOVIR LOADED MICROSPONGE

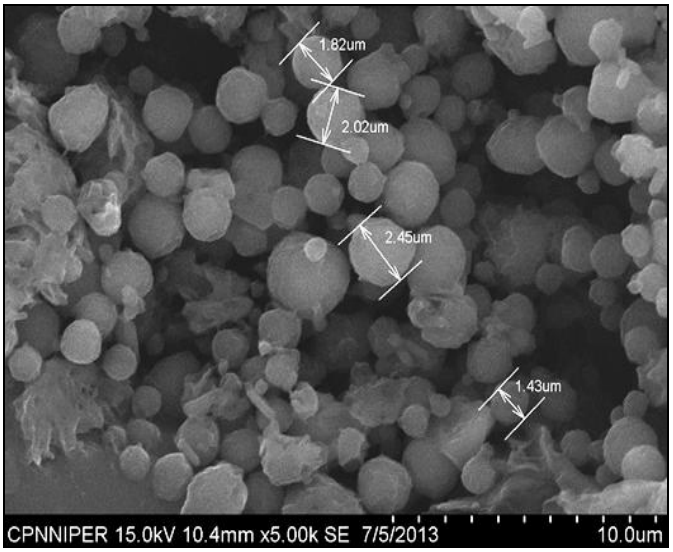


FIG. 6: SEM PHOTOGRAPH OF ACYCLOVIR LOADED MICROSPONGES

Plotting of release data in various models: The values of release data of drug was plotted in various models, on studying graphs of these models it was found that drug follows Korsemeyer-Peppas drug release model. **Fig. 14, 15, 16, 17 and 18** represent various drug release models.

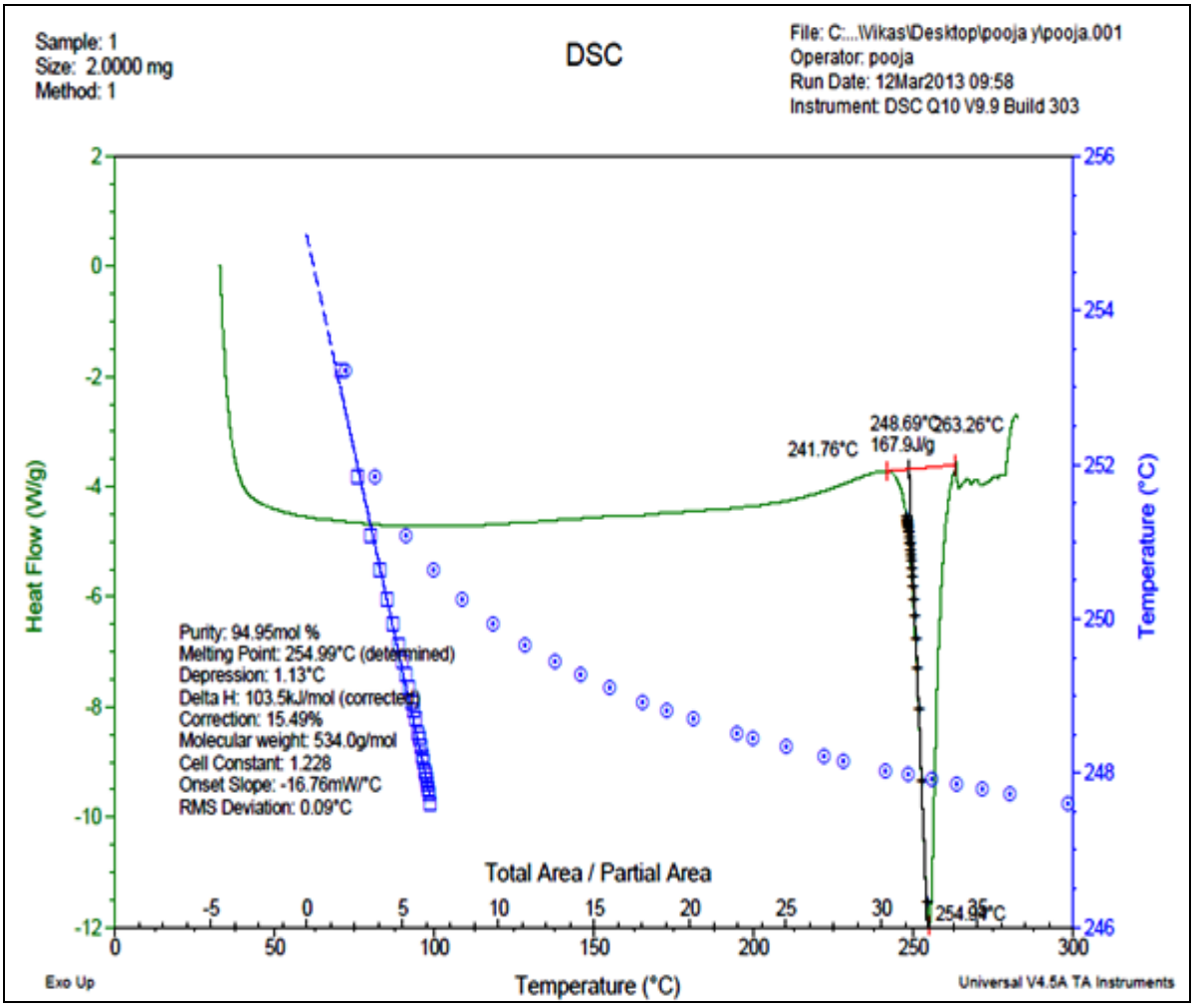


FIG. 7: DSC OF ACYCLOVIR

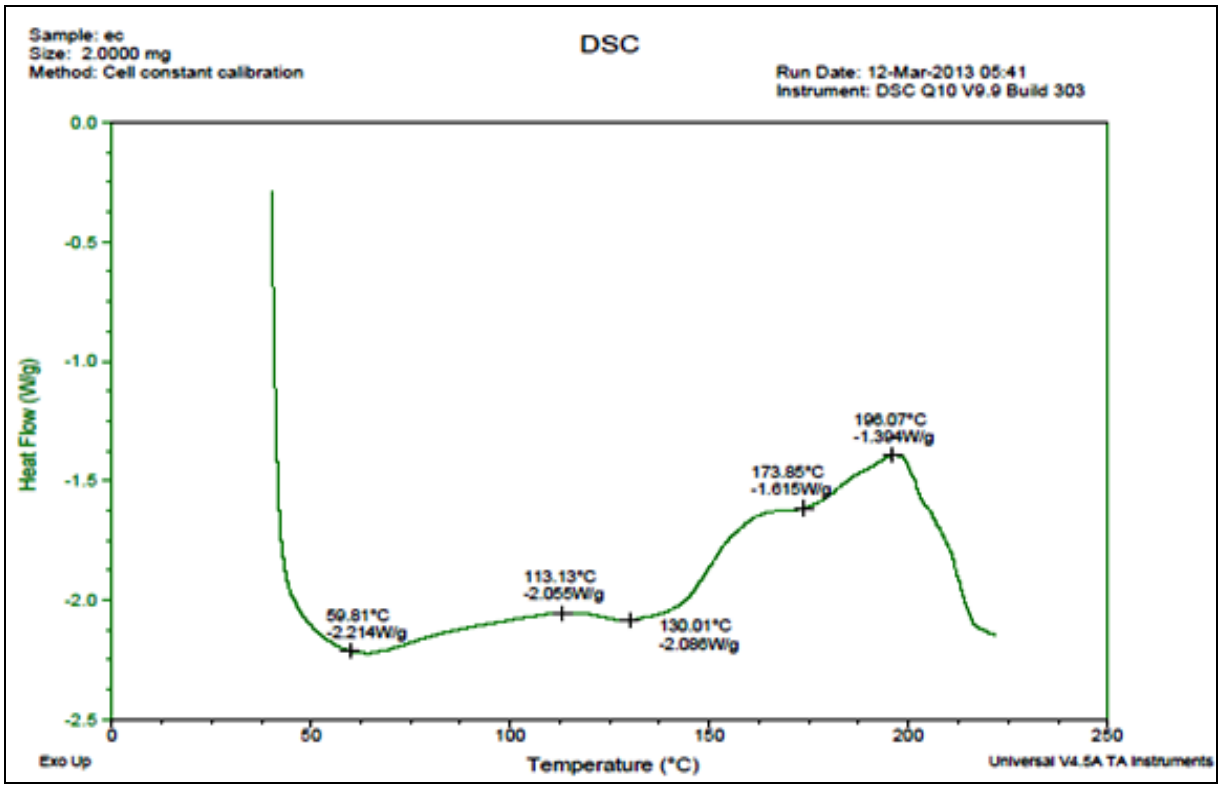


FIG. 8: DSC OF ETHYL CELLULOSE

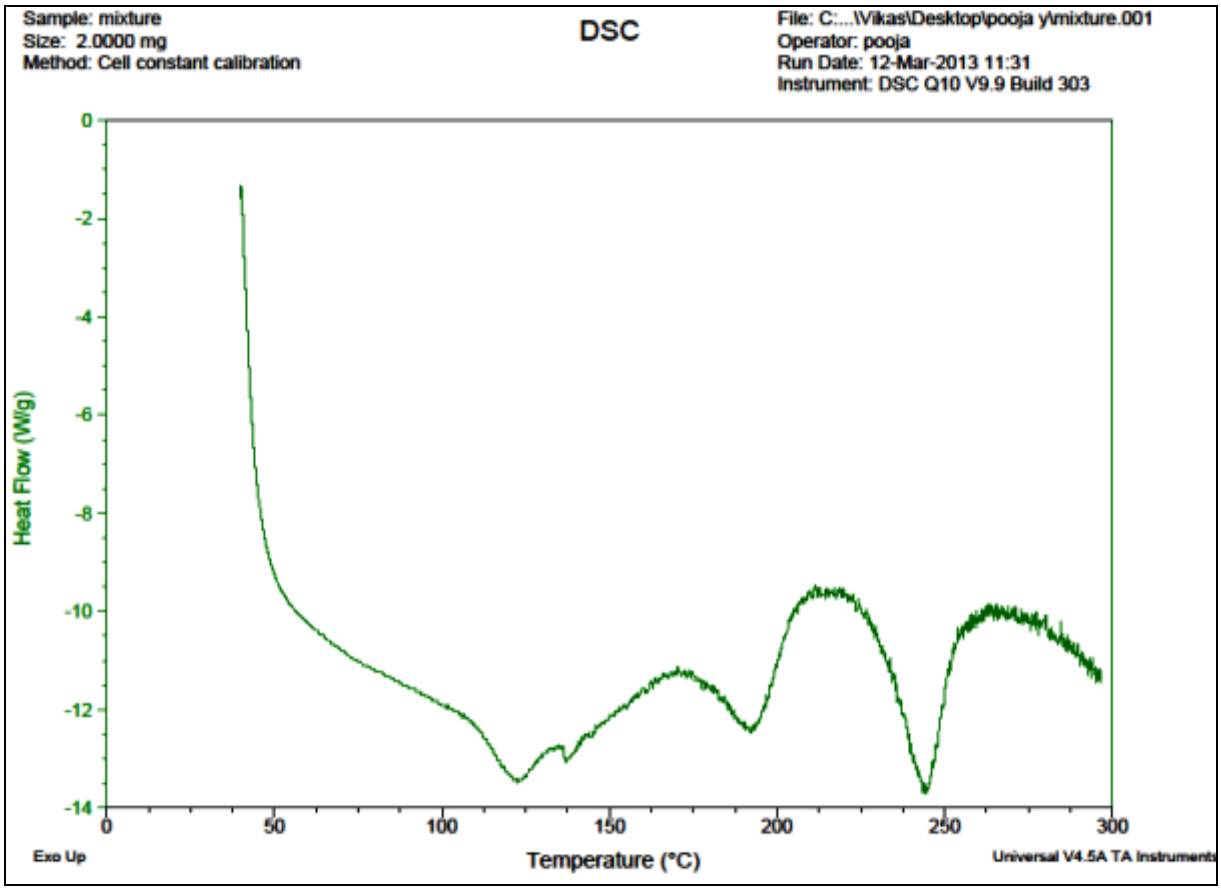


FIG. 9: DSC OF MIXTURE OF EC+PVA+ACYCLOVIR

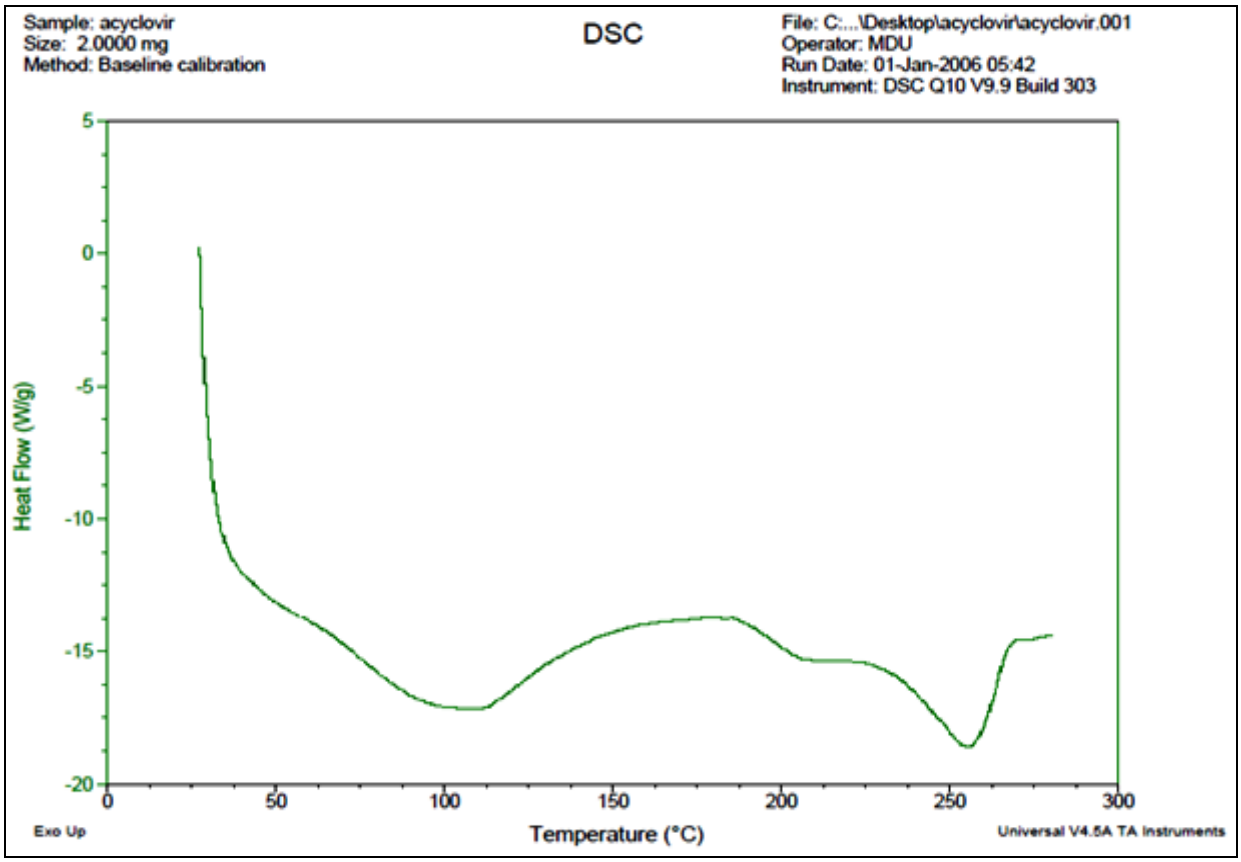


FIG. 10: DSC OF ACYCLOVIR LOADED MICROSPONGES

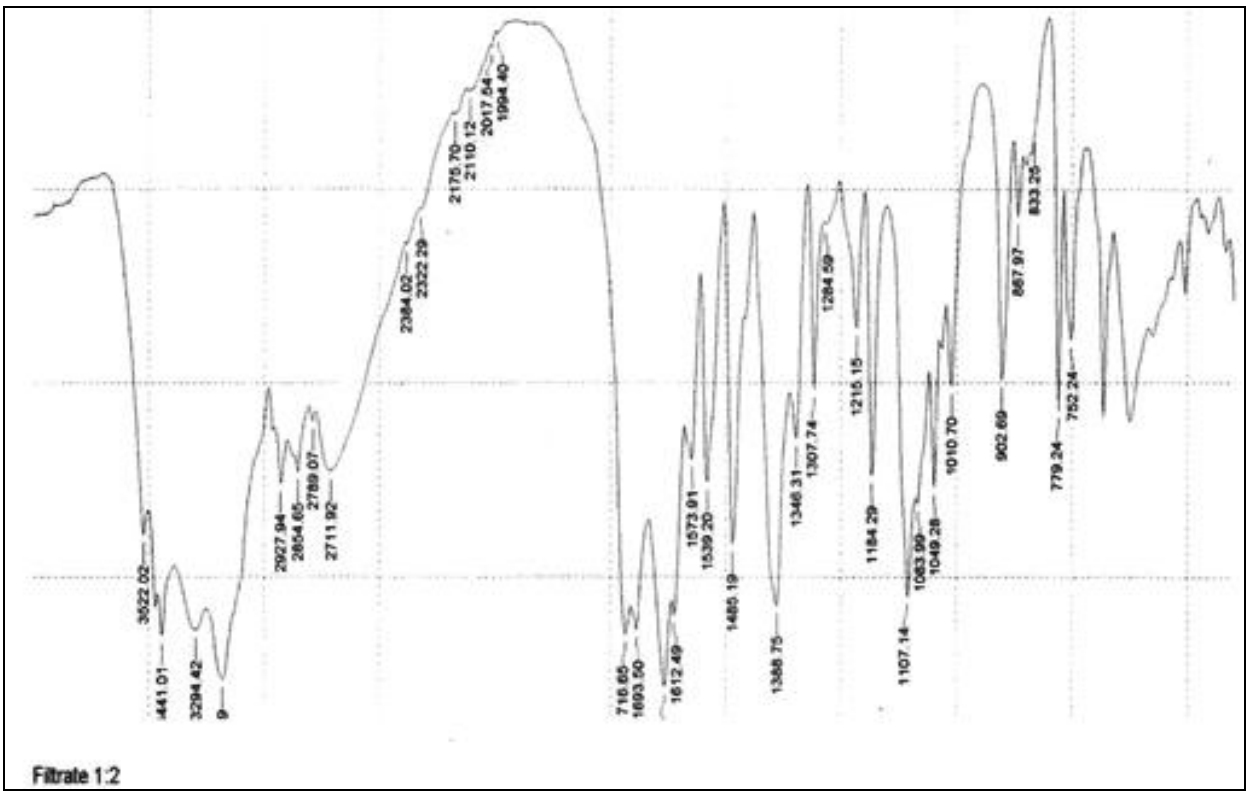


FIG. 11: I.R. SPECTRA OF ACYCLOVIR

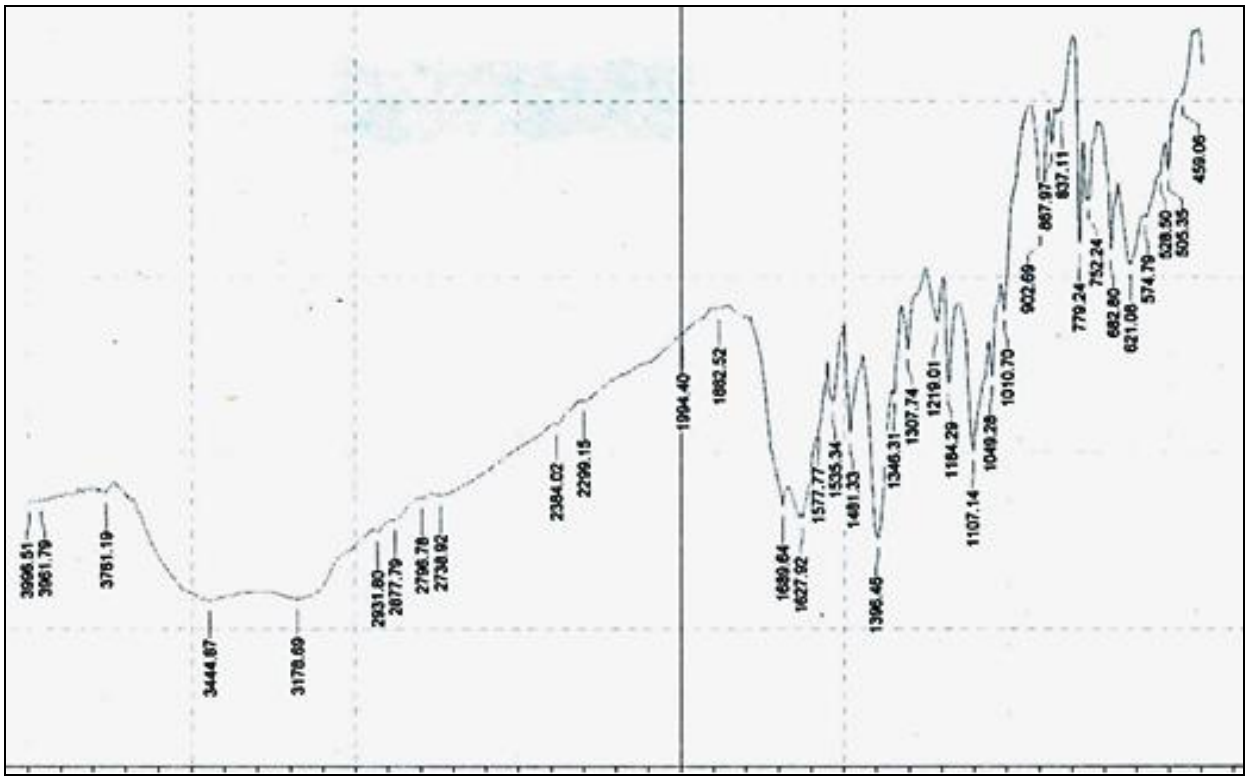


FIG. 12: I.R SPECTRA OF DRUG+ETHYL CELLULOSE

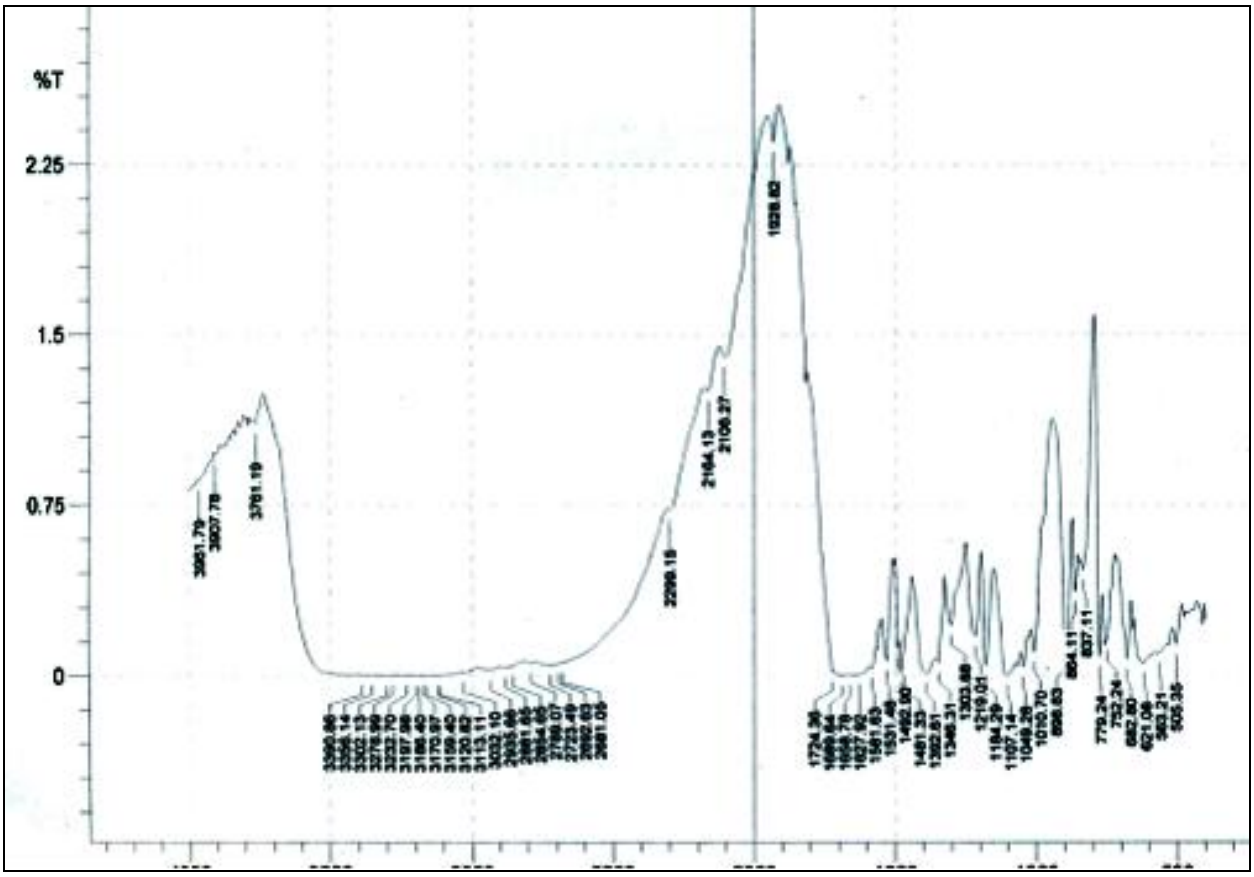


FIG. 13: I.R SPECTRA OF ACYCLOVIR LOADED MICROSPONGE

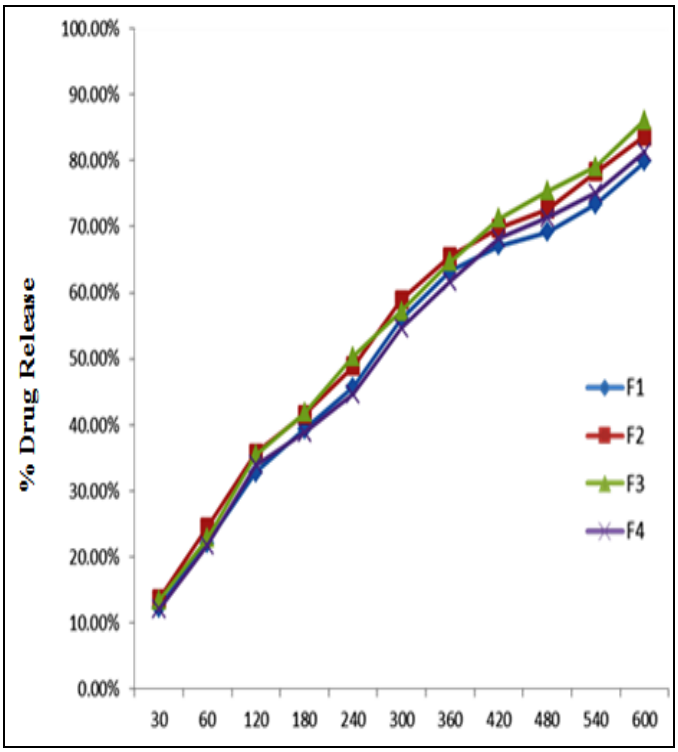


FIG. 14: COMPARATIVE *IN VITRO* RELEASE STUDY OF BATCHES OF MICROSPONGES

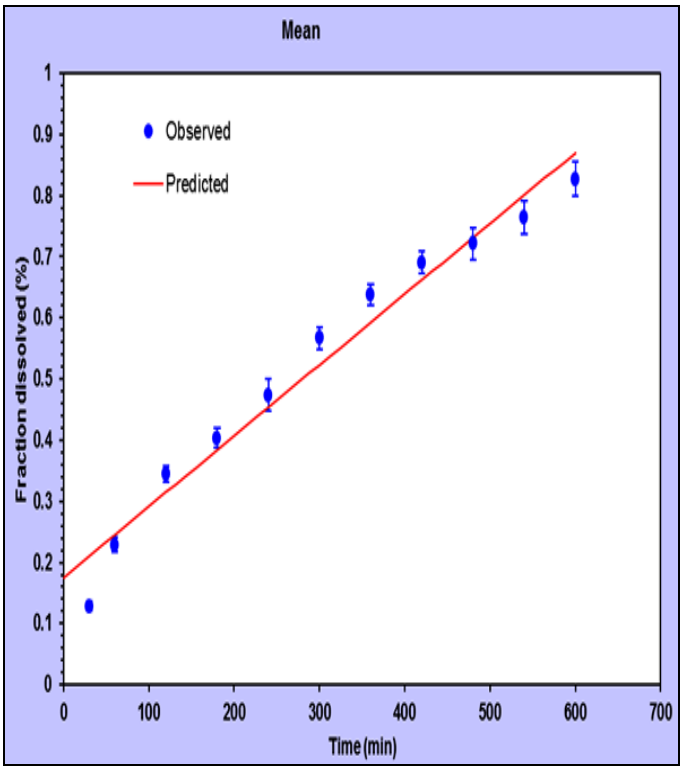


FIG. 16: FIRST ORDER PLOT

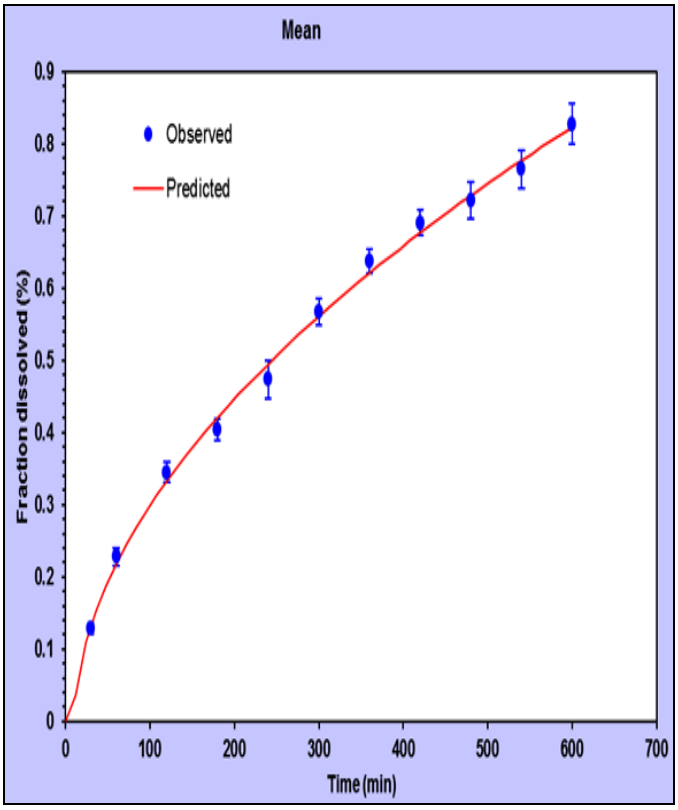


FIG. 15 ZERO ORDER PLOT

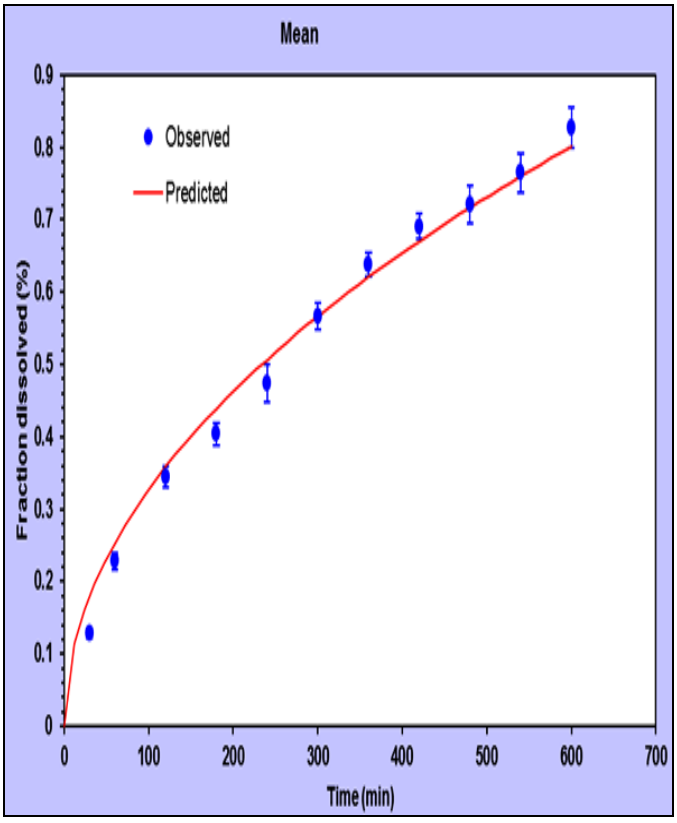


FIG. 17: HIGUCHI PLOT

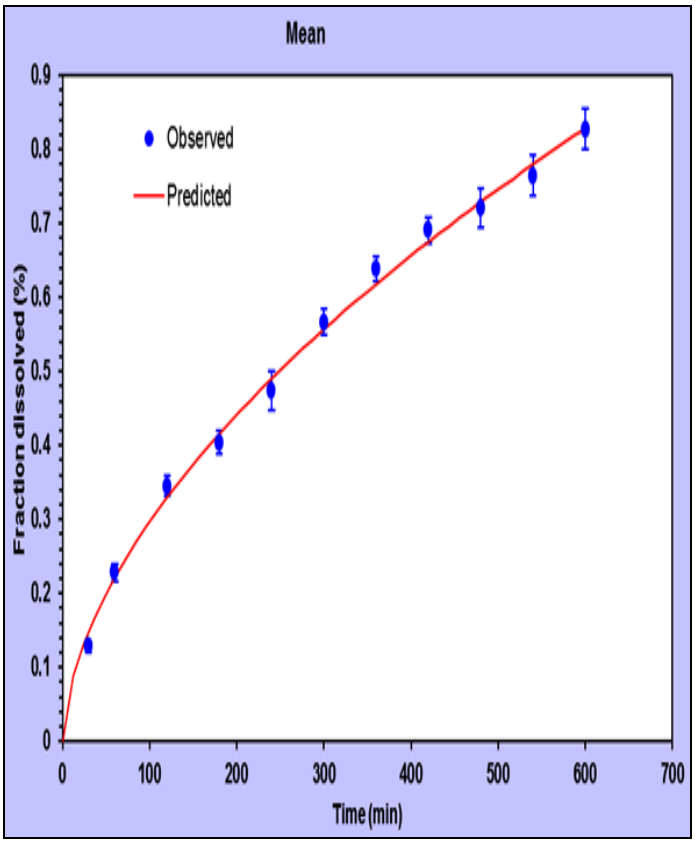


FIG. 18: KORSEMEYER-PEPPAS MODEL

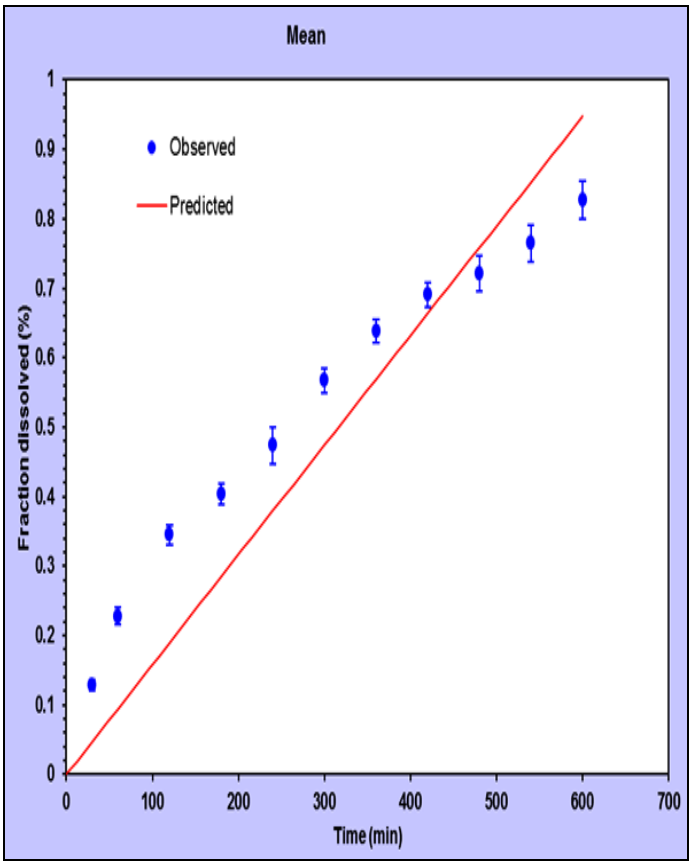


FIG. 19: HIXSON-CROWELL MODEL

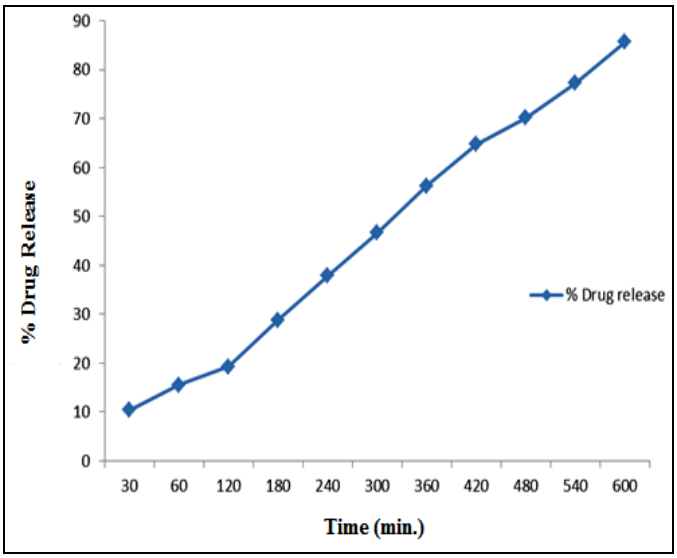


FIG. 20: DRUG RELEASE PROFILE OF ACYCLOVIR LOADED MICROSPONGE GEL

CONCLUSION: Microsponges containing Acyclovir were prepared by quasi emulsion solvent diffusion method using ethyl cellulose and PVA. By considering the solubility study of the drug and polymer and the rate of diffusion of the solvent used, the internal phase suitable for the preparation of microsponges to be ethanol and the external phase was found to be water. Mixture of Ethyl cellulose and drug in ethyl alcohol served as internal phase. Solution of PVA in water served as external phase. The concentration of the polymer required to produce microsponges with good physical and morphological characteristics was found to be 10-12% w/w of the drug. The minimum concentration of an emulsifier PVA required to produce microsponges was found to be 50 mg per 200ml. The particle size range increases as increase in amount of polymer in the formulation.

Loading efficiency of 4 batches of microsponges was estimated and it was found out that microsponge batch no. f2 has maximum loading efficiency.

DSC studies of pure drug and excipients and their mixtures show that there is no interaction between drug and excipients.

All the microsponge formulations were subjected to drug content estimation, the low SD values indicates drug content was uniform and reproducible in all the formulations. All the microsponge formulations were subjected for loading efficiency and the results were found to be reproducible.

The IR spectral analysis suggested that there was no interaction between the drug and formulation additive. The drug exists in original form and available for the biological action.

Dissolution tests were carried out using USP dissolution apparatus 1. The results show that as the concentration of polymer increases drug release was decreased.

From dissolution studies it was found out that microsponge batch no. f3 gave maximum drug release.

The release profile of the Acyclovir in the form of herbal microsponges gel was studied using franz diffusion cell. From the results it can be concluded that microsponge gel could sustain the drug release over period of 10 hours.

Medicated lipstick containing Acyclovir loaded microsponges was prepared and evaluated and it showed normal values as per lipstick standards and showed no sign of bleeding, streaking, blooming or streaking.

FIG. 19 DRUG LOADED MICROSPONGES

FIG. 20 FRANZ DIFFUSION CELL

FIG. 21: EXTRACTING EGG MEMBRANE

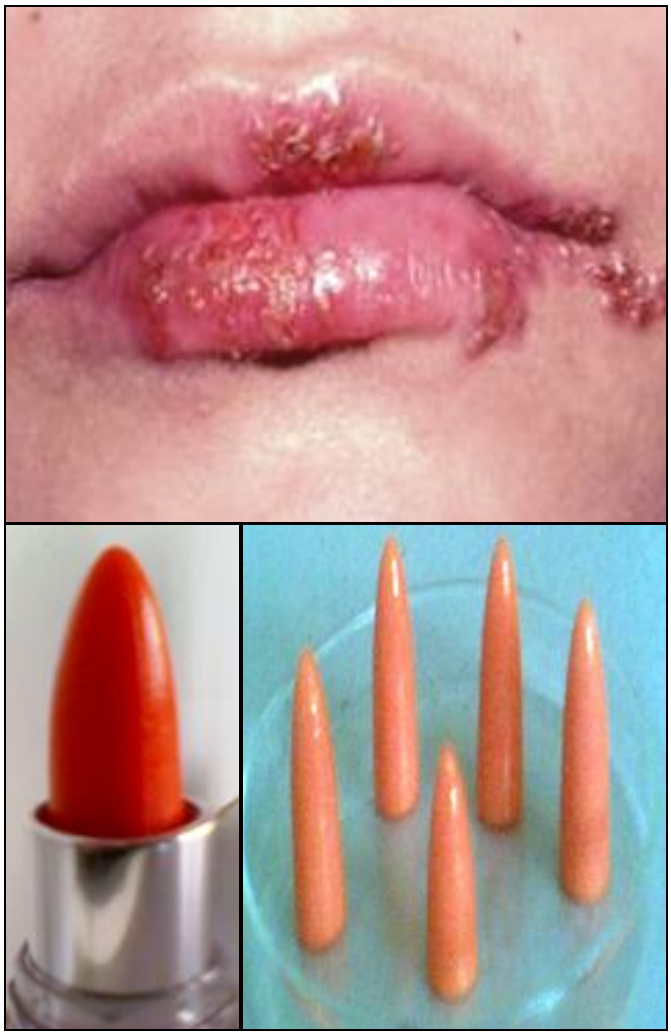
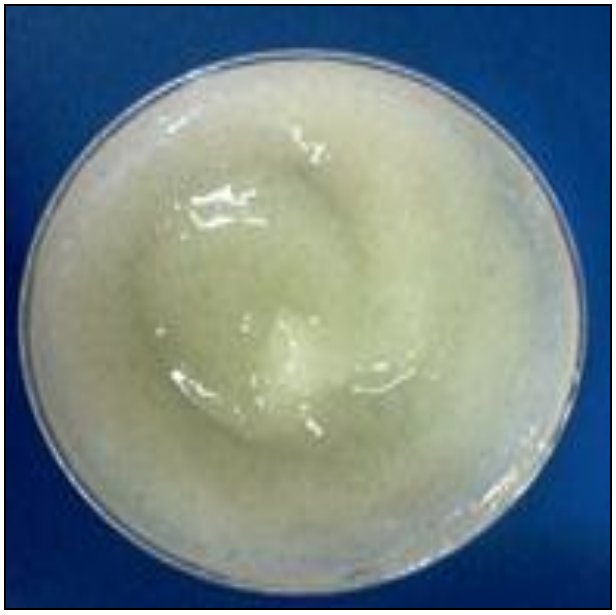


FIG. 22 PREPARED MICROSPONGE LOADED LIPSTICK FOR *HERPES LABIALIS*



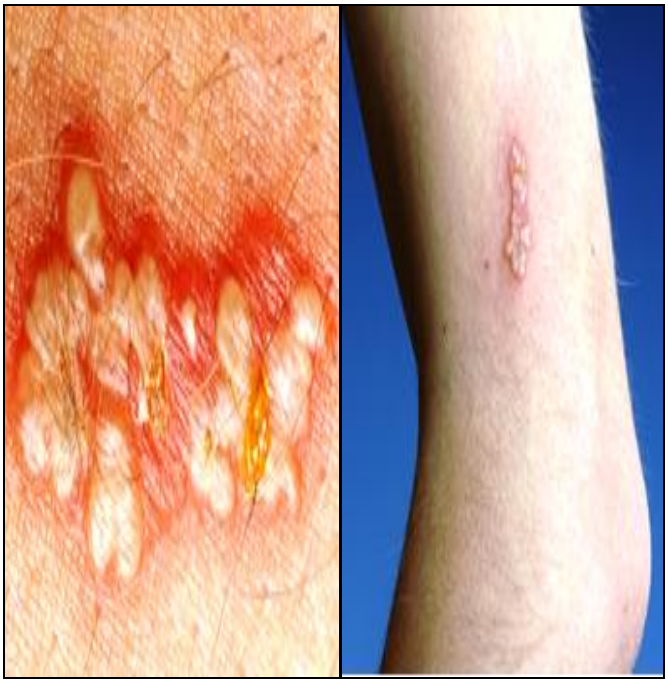


FIG. 23 PREPARED MICROSPONGE LOADED HERBAL GEL FOR TREATMENT OF *HERPES KERATITIS*

ACKNOWLEDGEMENT: Authors wish to thank Ranbaxy laboratories for providing the gift sample of the drug, Head, Department of Pharmaceutical Sciences for the facility provision to carry out the experiments, Department of Student Welfare (DSW) for providing funds.

REFERENCES:

1. Abdelmalak N.S., El-Menshawe S.F. A new topical fluconazole Microsponge loaded hydrogel: preparation and characterization. International Journal of Pharmacy and Pharmaceutical Sciences .2012; 4 (1): 460-468.
2. Amrutiya N., Bajaj A., Madan M. Development of Microsponges for topical delivery of mupirocin. AAPS PharmSciTech. June 2009; 10 (2): 402-9.
3. Comoglu T., Gonul N., Baykara T. Preparation and in vitro evaluation of modified release ketoprofen microsponges. I l Farmaco. 2003; (58): 101-6.
4. D'souza J. I. In-vitro Antibacterial and Skin Irritation Studies of Microsponges of Benzoyl Peroxide, Indian Drugs, July 2001; 38(7): 42-45.
5. Jelvehgari M, Siahi-Shadbad M.R., Azarmi S., Martin G.P., Nokhodchi A. The microsponge delivery system of benzoyl peroxide: preparation, characterization and release studies. International Journal of Pharmaceutics. 2006; 308:124–132.
6. Patel S.B., Patel H.J. *et al*, Microsponge drug delivery system: an overview. Journal of Global Pharma Technology. 2010; 2(8): 1-9.
7. Rekha U, Manjula B. P. formulation and evaluation of Microsponges for topical drug delivery of mometasone furoate. International Journal of Pharmacy and Pharmaceutical Sciences. 2011; 3(4): 133-37.
8. Prasad M.S.C., Ajay M. Microsponge drug delivery system: A Review Journal of Pharmacy Research. 2011; 4(5): 1381-84.
9. Vyas S and Khar RK. Controlled Drug Delivery-Concept and Advances, Vallabh Prakashan, 2002: 418-22.
10. Verma R.K., Garg S. Current Status of Drug Delivery Technologies and Future Directions. Pharmaceutical Technology On-Line**,** 2001; 25 (2): 1–14.
11. Tripathi K.D., ―Essentials of Medical Pharmacology, Jaypee Brothers Medical Publisher, New Delhi. 2007. 4th Ed., 770-73.
12. Saller R, Buechi S, Meyrat R, Schmidhauser C. Combined herbal preparation for topical treatment of Herpes labialis. Forsch Komplement armed Klass Naturheilkd. 2001; 8(6):373-382.
13. Corey L, Nahmias AJ, Gainan ME *et al*. A trial of topical acyclovir in herpes simplex virus infection. N Eng J Med 1982; 386:1313-1316.
14. Syed TA, Afzal M, Ashfaq Ahmad S, *et al*. Management of genital herpes in men with 0.5% Aloe vera extract in a hydrophilic cream: a placebo-controlled double-blind study. J Dermatol Treat. 1997; 8: 99-102.
15. Gold D, Corey L. Acyclovir prophylaxis for herpes simplex virus infection. Antimicrob agents Chem 1987; 31: 361-365.
16. Basha BN, Prakasam K, Goli D: "Formulation and evaluation of gel containing fluconazole- antifungal agent", International Journal of Drug Development and Research 2011; 3(4).

How to cite this article:
Yadav P and Nanda S: Development and evaluation of some Microsponge loaded medicated topical formulations of Acyclovir. *Int J Pharm Sci Res* 2014; 5(4): 1395-10.doi: 10.13040/IJPSR.0975-8232.5(4).1395-10