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ORIGINAL ARTICLE **OPEN ACCESS**

Formulation and characterization of griseofulvin loaded nanosponge

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ABSTRACT
The objective of the current study was to formulate and characterize the optimum stable nanosponges of Griseofulvin using the method of emulsion solvent diffusion and to increase the solubility, bioavailability and controlled release of the drug. The Griseofulvin loaded nanosponge was formulated by using emulsion solvent diffusion method having different drug-polymer ratios (1:0.5 to 1:2). Ethyl cellulose is used as a polymer. Differential scanning calorimetry (DSC) and Fourier transform infrared spectroscopy (FTIR) estimated the compatibility of Griseofulvin with polymer. All formulations evaluated for production yield, drug content, entrapment efficiency, particle size, zeta potential, in vitro drug release, powder x-ray Diffractometry, scanning electron microscopy (SEM) and stability studies.The DSC and FTIR studies indicate that the new formulation has no association between the use of drugs and polymers. The production yield is in the range of 64±0.30 to 90±0.32 for all formulations. Batch X5 showed the highest production yield, the drug content and entrapment efficiency of batch X5 respectively as 86.54 ± 0.13 and 76.28 ± 0.11. The average particle size ranges from 340.12 ±2.52 to 535.73±2.66 nm. By the end of 12th hour X5 formulation shown highest drug release was found to be 95.59±1.12%. The release kinetics of the optimized formulation shows zero-order drug release. The stability study of optimized formulation indicates no significant change in the in vitro dissolution study. The results of different evaluation parameters showed that griseofulvin nanosponges could be used to enhance its solubility, bioavailability and alternative delivery systems to conventionalformulations. The emulsion solvent diffusion method is prefer method for formulation of nanosponges and release the drug in sustained and controlled manner.
Keywords: *Nanosponge, Griseofulvin, Emulsion solvent diffusion method.*

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INTRODUCTION

Nanosponges are a modern sustain and control realese drug delivery system, they have nano-structured hyper branched polymers and few nanometers wide cavities, in that a large variety of substances can be encapsulated i.e. hydrophobic and hydrophilic. A medical researcher have a long problem for a drug to convert into targeting drug delivery system i.e. how to place into right place into the body and how to control the release of particular drug from overdose. Nanosponges are one of such effective drug delivery system which con- quer this problem . The nanosponge drug delivery platform is a network of specific polymers that slowly degrades and thus releases the chosen drug. Nanosponges are nano size with sponge like morphology. They are a spherical, colloidal in nature, as well as they have a very high solubilisationcapacity to the poorly soluble drugs by their inclusion and non-inclusion behavior.[1] Nanosponges is a modern dosage form in that poorly water soluble drug encapsulated and provide prolonged release as well as improving drugs solubility and bioavailability.[2] Nanosponges are able to load both hydrophilic and hydrophobic drug molecules because of their inner hydrophobic cavities and external hydrophilic branching, thereby offering unparalleled flexibility.[3] The size of nano- sponge very virus in nature below 1micrometer look like a scaffold structure of naturally degradable polyester. The small molecules are mixed into the long length of polyesters strands that is called as cross-linkers they

have an affinity to certain portions of the polyester. Many types of drug are stored in a pocket (cavity) of a cross-link segment of the polyester have a spherical shape in nature. The polyesters are biodegradable in nature, They means that when they breakdown in the body, the drug can released to a known specific.[4]
The nanosponge formulation represent a novel sustain and control class of nano- particles, they obtained by natural derivatives. As compared to the other nanoparticles, they have high solubility in both water and organic solvents. Nanosponge are porous in nature, non-toxic and stable at high temperatures up to 300°C.[5] The nanosponges can be synthe -sized to be of specific size below the 1 mm and to release drugs over time by changing the proportion of cross linker to polymer. The loading capacity of drug in the nanosponge is depend on the particular proportion of polyesters and cross-linking peptides, compared to many other nano scale drug delivery systems.[6] Nanosponge have useful to pulmonary and venous drug delivery system by formulating in tiny shape.[7]
Griseofulvin is fungi static,antifungal drug. However the mechanism of griseofuvin drug molecule is the inhibition of growth of dermatophytes. The inhibition of dermatophytes growth by inhibition of fungal cell as well as nuclear acid synthesis. Griseofulvin also bind to interferes they have a function of mitotic spindle and they also bind to alpha and beta tubulin of cytoplasmic microtubule. The keratin cell present in human body the griseofulvin bind to keratin cek in the human body, and reach to the fungal site of action, then bind to fungal micro tubes hence altering the fungal process of mitosis.[8,9]

MATERIALS AND METHODS

MATERIALS

Griseofulvin was provided by yarrow chem laboratory Mumbai, India. Ethyl cellulose provided by Evonik Mumbai. Polyvinyl Alcohol (PVA), Dichloromethane (DCM), was obtained from pallav laboratorypvt ltd, satara, maharastra,India

Preformulation studies of pure drug:

The received sample of Griseofulvin was subjected to the Preformulation studies.

Physical characteristics:

By visual examination, the drug was identified for physical characters like colour,texture.

Melting point:

The open ended capillary tube is use for the melting point where Small amount of drug was loaded in capillary tube and one end is close by heating. kept in melting point apparatus and temperature was noted when drug melts.[10]

Solubility studies:

Griseofulvin practically insoluble in water and petroleum ether, slightly soluble in ethanol, chloroform, methanol, acetic acid, acetone, benzene and ethyl acetate. Soluble in n, n-dimethyl formamide.

4. Spectrophotometriccharacterization:

Determination of λ max of glimepiride in methanol :

The standard solution (10µg/ ml) of pure drug (griseofulvin) was prepared in freshly prepared methanol. The prepared solution was scanned between 400-200 nm by uv- visible spectrophotometer (jasco v-530).[11]

Preparation of calibration curve of glimepiride in methanol:

The calibration curve griseofulvin was prepared in methanol. Griseofulvin showed maximum absorption at wavelength 293.0 nm respectively. The straight line obtained in the 0.1n methanol had a regression coefficient of 0.9993. Linearity was found in the concentration range of 2-12 µg/ml.

Drug-excipient compatibility studies:

The drug and excipient compatibility studies was perform by using Fouriertransform-infrared spectroscopy (FT-IR). The Potassium Bromide pellets were prepared on KBr press on grounding the solid powder sample with 100 times the quantity of KBr in mortar. The spectra recorded over the wavenumber of 4000 to 400 cm-1.[12]

METHODS

Preparation of nanosponges:

Griseofulvin loaded nanosponge were prepared by using emulsion solvent diffusion method. In this method, two phases used are aqueous and organic. Aqueous phase consists of polyvinyl alcohol and organic phase include Griseofulvin and Ethyl cellulose. After dissolving Griseofulvin and Ethyl cellulose to suitable organic solvent. This phase added slowly to the aqueous phase and stirred for two or more hours and then nanosponges are collected by filtration, washed, and then dried in air at room temperature or in vacuum oven 40 °C for 24 h. [13, 14]

TABLE 1: FORMULATION OF NANOSPONGES

Ingredients	X1	X2	X3	X4	X5	X6	X7	X8
Drug: Polymer. (mg)	100:50	100:100	100:150	100:200	100:50	100:100	100:150	100:200
PVA (%w/v)	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Dichloromethane(ml)	20	20	20	20	20	20	20	20
Distilled Water (ml)	100	100	100	100	100	100	100	100

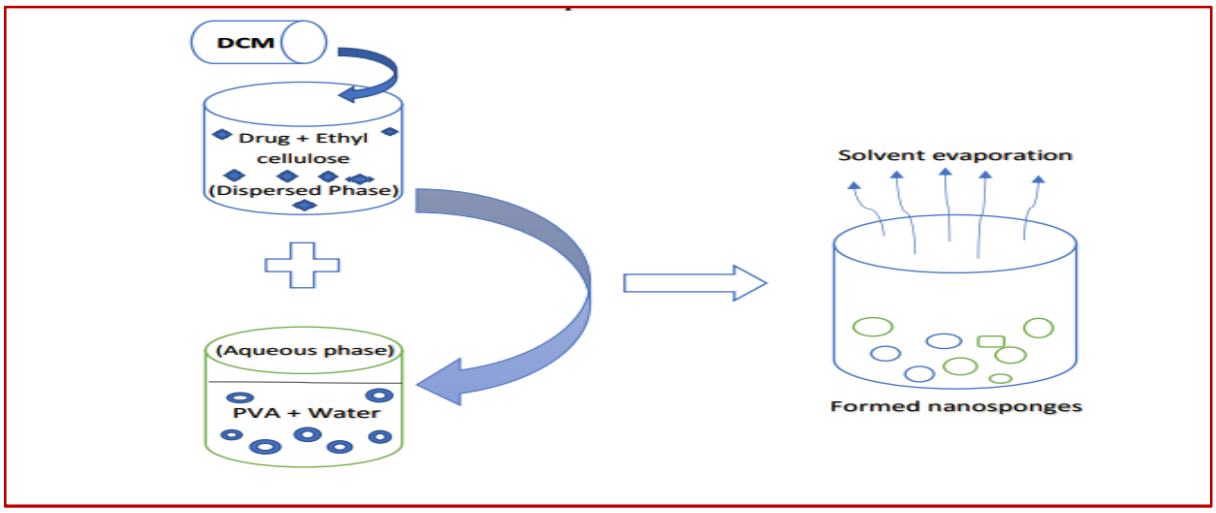


FIG 1: PREPARATION OF NANOSPONGE BY SOLVENT EVAPORATION METHOD.

EVALUATIONOFNANOSPONGES

Determination production yield:

The production yields (PY) of the current formulations are determined by calculating initial weight of drug and polymer and final weight of nanosponges.

$$\text{Production yield} = \frac{\text{Practical mass of nanosponges}}{\text{Theoretical mass(polymer + drug)}} \times 100$$

The percentage yield of different batches was determined by weighing the nanosponges after drying. [15,16]

Determination drug content:

To study the amount of drug incorporated in the nanosponges, Griseofulvin was extracted from the nanosponges by dissolving them in 25 ml Methanol. The resulting solution was filtered through a watt-manfilter paper. The Griseofulvin content in the methanolic extracts was analysed spectrophotometrically by using UV-Visible spectrophotometer (JASCO V530) at a wavelength of 291.0 nm, against methanol as blank.[17,18]

% drug content = (Wa / Wt)× 100

Where,

Wa = Actual drug content and

Wt = Theoretical drug content.

Determination entrapment efficiency:

To calculate the entrapment efficiency, accurately weighed quantity of nanosponges (10mg) with 5 ml of methanol in a volumetric flask was shaken for 1min using vortex mixer. The volume was made up to 10 ml . Then the solution was filtered by watt-man filter paper and diluted and the concentration of Griseofulvin was determined spectrometrically at 291.0nm.[19,20]

$$\text{Loading Efficiency} = \frac{\text{Actual drug content in nanosponge}}{\text{Theoretical drug content}} \times 100$$

Determination of particle size and zeta potential:

The size of particles is maintained during polymerization for the formation of free-following powders having fine aesthetic attributes. Particle size analysis of loaded and unloaded nanosponges performed by laser light diffractometry or Malvern zeta sizer. The cumulative graph is maintained or plotted as particle size against time to study effect of particle size on drug release.[21]

***In-vitro* drug release studies:**

Preparation of 0.1N HCL:

By taking 8.3 ml 35% hcl in 1000 ml of distilled water to get form 0.1N HCL. By using this media in-vitro study were perform.

Griseofulvin loaded nanosponges were characterized for *in-vitro* drug release test as per noted in European pharmacopoeia using dissolution apparatus 2 (Lab India, DS8000). Take accurately weighed amount of nanosponges equivalent to 250 mg of griseofulvin was placed in a clean muslin cloth washed with distilled water and kept soaked in 0.1N HCL. Then this bag was tied to the paddle and suspended in to 900 mL of 0.1N HCL used as dissolution medium at paddle rotation speed of 50 rpm and temprecture 37±0.2 °C. Samples was withdrawn from the dissolution medium at predetermine intervals for 1hr interval for 12hr. and Griseofulvin released was spectro-photometrically determined at 293 nm. Experiment was carried out in triplicate for the period of 12 h. Cumulative percentage of drug release versus time plot of prepared nanosponge was compare with the pure drug use for that formulation.[22]

EVALUATION OF OPTIMIZE FORMULATION

Fourier-transform infrared analysis:

Fourier-transform infrared (FTIR) spectra of pure Griseofulvin and pure polymer (EC), and nanosponges of drug Griseofulvin was taken to access interaction, if any between drug and polymer in mixtures. The scanned mixture by using an FTIR spectrophotometer (BRUKER-TENSOR 37). The FTIR spectra of mixtures were compared with that pure drug and polymer used in formulation to assess any change in the principal peaks of spectra of pure drug and polymer.[23]

Differential scanning calorimetry:

Differential scanning calorimetric (DSC) studies of pure Griseofulvin, pure polymer (EC) and nanosponges of drug Griseofulvin with ethyl cellulose was performed to assess what changes had actually occurred when nanosponges were formed and by what phenomenon these enhanced drug solubility. The samples was kept on DSC reference pan and DSC curves were obtained by differential scanning calorimeter (DSC 60-Shimadzu) at a heating rate of 10°C/min from 0 to 300°C in nitrogen atmosphere.

Scanning electron microscopy studies:

Scanning electron microscopy (NOVA NANO SEM 450) was used to analyze particle size and surface topography was operated at 15kV acceleration voltage. A condensed aqueous suspension was spread and vacuum-dried over a slab. The sample was shadowed with a gold sheet 20 nm thick in a cathodic evaporator. An image processing software developed images and measured individual NP diameters to obtain a mean particle size.SEM images of optimized griseofulvin loaded nanosponge formulation given in figure 22(a) and 22(b) confirmed the Sponge like 3dimentional and porous structure of prepared nanosponge formulation having numerous orifices. This are formed by diffusion of crosslinking agent dichloromethane which is characteristic feature of this formulation.[24]

Powder x-ray diffraction studies:

The PXRD pattern of the optimize nanosponge formulation by using an x-ray diffract meter (RigakuUltima IV) with a voltage and current of 40 kV/20 mA having an auto sampler was recorded. Samples were scanned from 5 and 60° 2θ with continuous scanning type having k-beta filter. Any changes in characteristic peaks deviating from the standard drug was indentified to confirm encapsulation of the drug.[25]

Stability studies

Accelerated stability studies: -40°C ± 2°C/75%RH±5%RH. As per ICH guidelines, the samples for stability analysis must be exposed to an environment of 40˚C ±2˚C/75%RH±5 % RH for a period of 6 month. As per the standard protocol, the samples must be analysed at 0, 1, 2, 3-and 6-months' time points. Accelerated stability studies were performed for the final optimized formulation. Samples were analysed at 1,2mo' time points.[26]

RESULT AND DISCUSION

Preformulation studies of pure drug:

Physical characteristics:

The pure drug has a white in nature or colourless powder. They have a characteristic odour.

Melting point:

The melting point of pure griseofulvin drug was fond 220^0C. While the standard range of griseofulvin drug is 218^0-220^0C.[26]

Spectrophotometric characterization:

Calibration Curve of Glimepiride in methanol

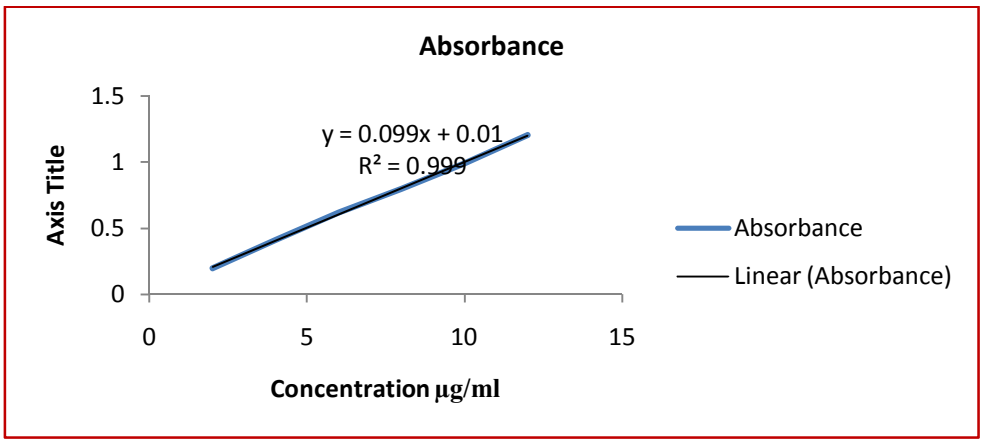


FIG 1: CALIBRATION CURVE OF GLIMEPIRIDE IN METHANOL.

Drug-excipient compatibility studies:
Fourier-transform infrared analysis:
FT-IR spectra of Griseofulvin

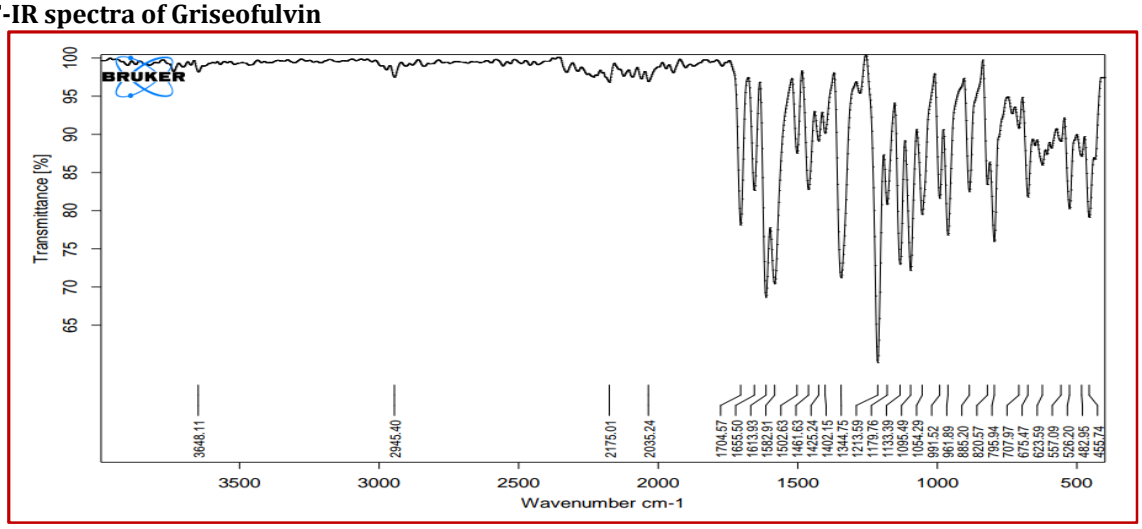


FIG 2: FT-IR SPECTRA OF GRISEOFULVIN

FT-IR spectra of Griseofulvin and Ethyl cellulose (Physical mixture)

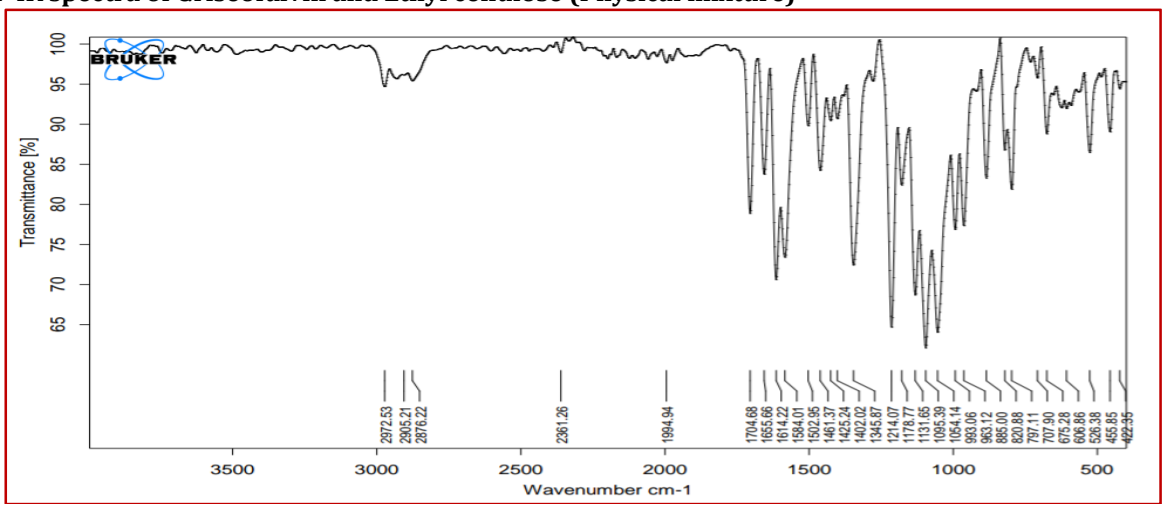


FIG 4:FT-IR SPECTRA OF GRISEOFULVIN AND ETHYL CELLULOSE (PHYSICAL MIXTURE).

Differential scanning calorimetry:
DSC Thermogram of Griseofulvin

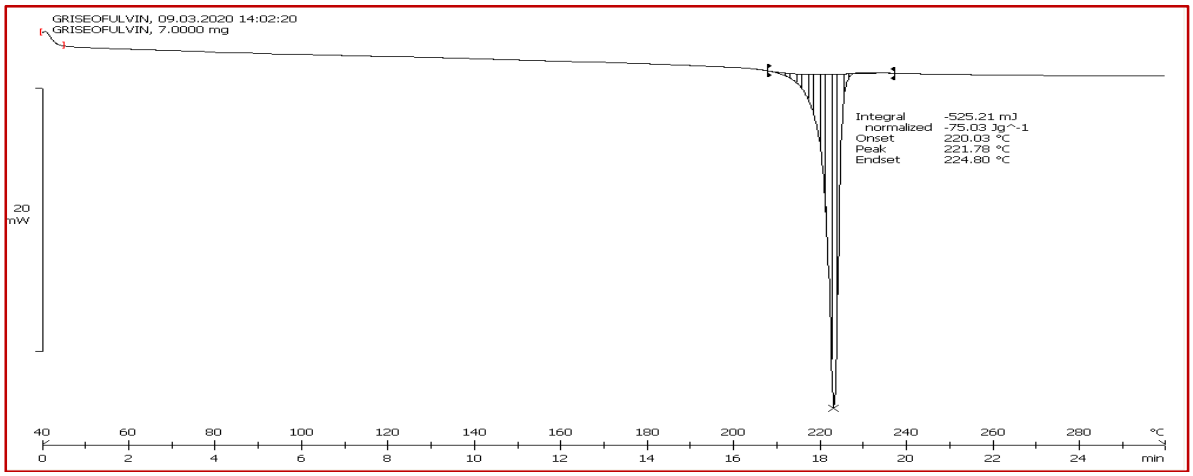


FIG 5: DSC THERMOGRAM OF GRISEOFULVIN.

DSC Thermogram of Physical mixture of Drug and Polymer

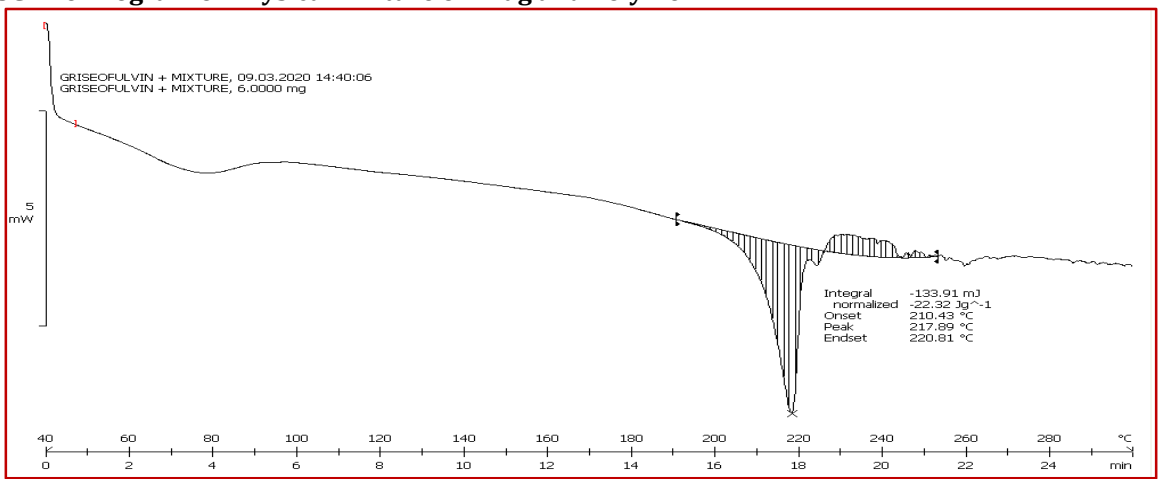


FIG 6: DSC THERMOGRAM OF PHYSICAL MIXTURE OF DRUG AND POLYMER (1:1).

EVALUATION OF NANOSPONGES

Determination production yield:

The production yields (PY) of the current formulations areDetermine by calculating final weight of nanosponge divided by initial weight of drug and polymer. The percentage yield of different batches was determined by weighing the nanosponges after drying. The percentage yields of different formulations were found to be in the range of 64±0.30% - 90±0.32% as shown in below table.

TABLE 3: PERCENTAGE YIELD OF DIFFERENT BATCHES OF NANOSPONGES

Sr. no.	Batch	Yield (%)
1	X1	90
2	X2	60
3	X3	87
4	X4	76.5
5	X5	82
6	X6	64
7	X7	67
8	X8	88

Determination of drug content and entrapmentefficiency:

The various batches of the nanosponges were subjected for drug content analysis. The powdered nanosponges (30 mg) were dissolved in adequate quantity (100 ml) of methanol then filter. The UV absorbance of the filtrate was measured using a UV spectrophotometer at 229 nm.

The drug content of different formulation was found to be in the range of 73.66 ± 0.25to 86.54 ± 0.13as shown in below table 4.

The drug entrapment efficiency of perapred formulations found in the range of 62.8±0.22 to 73.1±0.39 as shown in below table 4.

TABLE 4: DRUG CONTENT AND DRUG ENTRAPMENT VALUES OF DIFFER- ENT BATCHES OF NANOSPONGES.

Sr No	Batch	Drug content (%)	Entrapment efficiency (%)
1	X1	86.11 ± 0.1	83.85± 0.12
2	X2	76.28 ± 0.11	68.90± 0.45
3	X3	73.66 ± 0.25	64.24± 0.37
4	X4	84.16 ± 0.07	81.63± 1.4
5	X5	86.54 ± 0.13	84.44± 0.1
6	X6	78.72± 0.11	72.96± 0.054
7	X7	81.00 ± 0.07	76.54± 0.12
8	X8	73.66 ± 0.25	64.24± 1.8

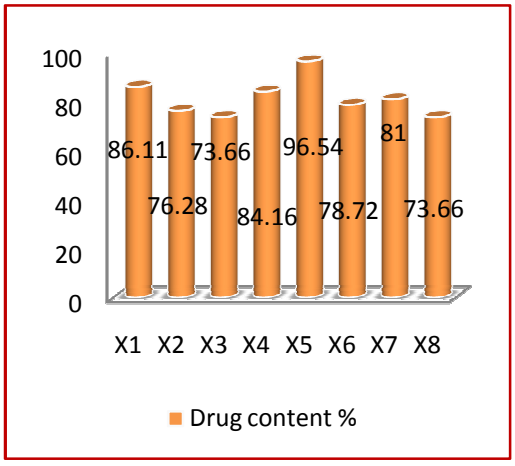


FIG 7: (A) % OF DRUG CONTENT

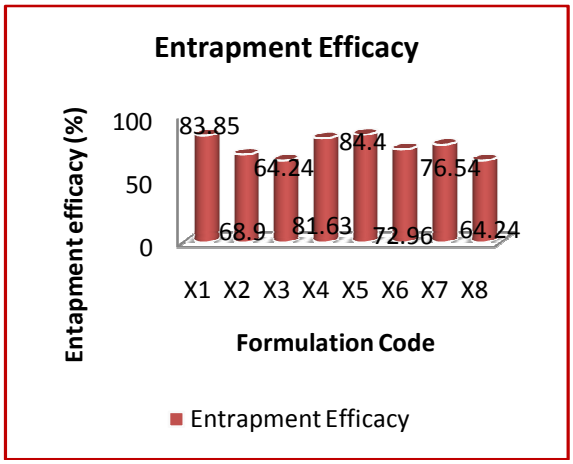


FIG 7: (B) % OF DRUG ENRAPMENT

Determination of particle size and zeta potential :

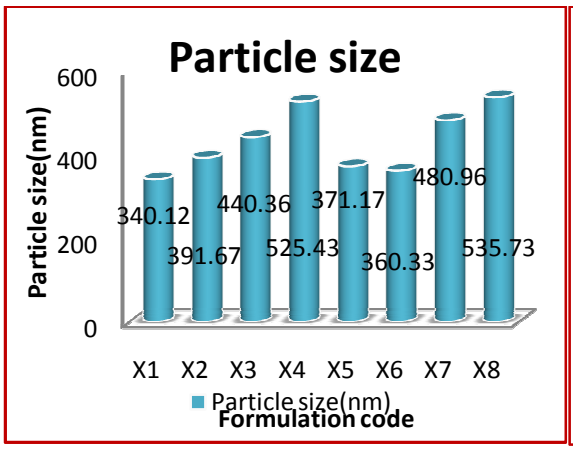
The average particle size griseofulvin nanosponge was obtained in range of 340.12 ±2.52 nm to 535.73± 2.66nm. The change in the concentration of polymer results in vari- ation of particle size of nanosponges.

The average particle size of formulation X1 showed minimum particle size i.e. 371.17± 2.51nm while formulation X9 showed maximum particle size i.e. 535.73± 2.66nm. An incre- ase in the concentration of polymer leads to increase in the particle size of nanosponges.

The average zeta potentials of griseofulvin nanosponges formulations were obtain in range -10 to -15 mV to stabilize the formulation

TABLE 5: PARTICLE SIZE AND ZETA POTENTIAL OF DIFFERENT BATCHES OF NANOSPONGE

Sr. No.	Formulation code	Particle size(nm)	Zeta potential (mv)
1	X1	340.12 ± 2.52	-5.1
2	X2	391.67 ± 2.71	-11.7
3	X3	440.36 ± 2.2	-14.9
4	X4	525.43 ± 2.66	5.10
5	X5	371.17 ± 2.51	-1.09
6	X6	360.33 ± 2.59	-8.6
7	X7	480.96 ± 2.2	-16.4
8	X8	535.73 ± 2.66	8.12



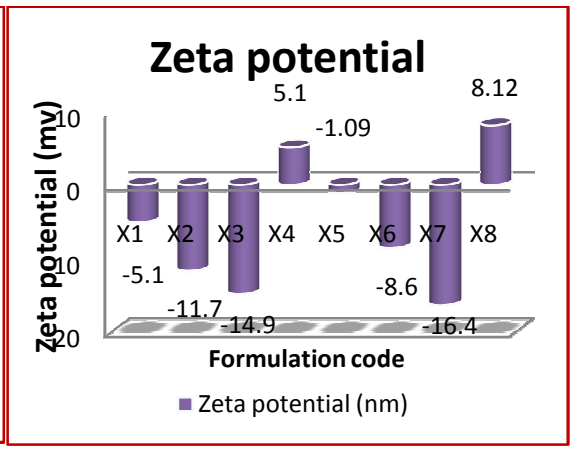


FIG 8: (A) % OF PARTICLE SIZE FIG 8: (B) % OF ZETA POTENTIAL

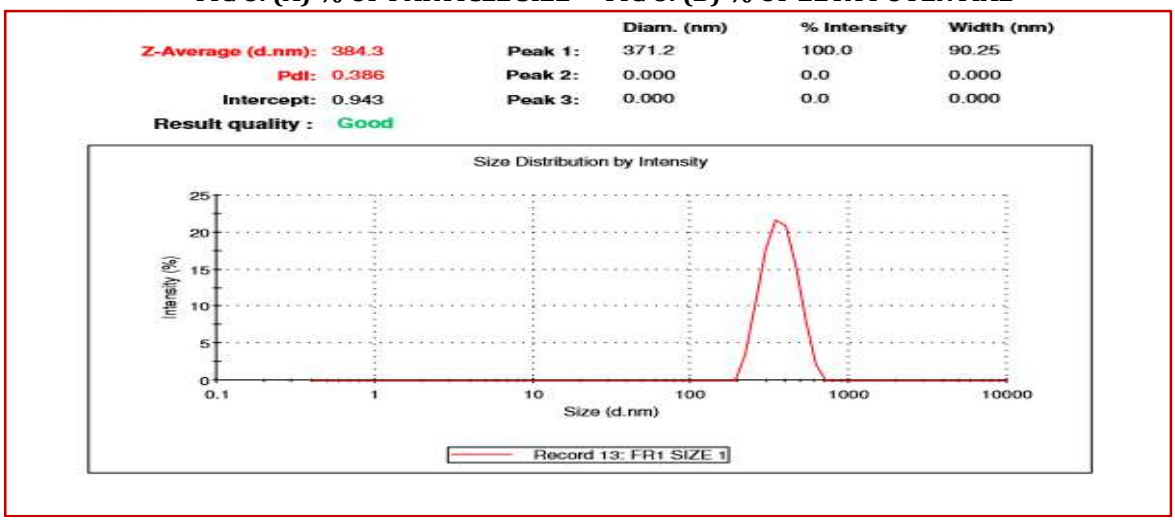


FIG 9: PARTICLE SIZE OF NANOSPONGES

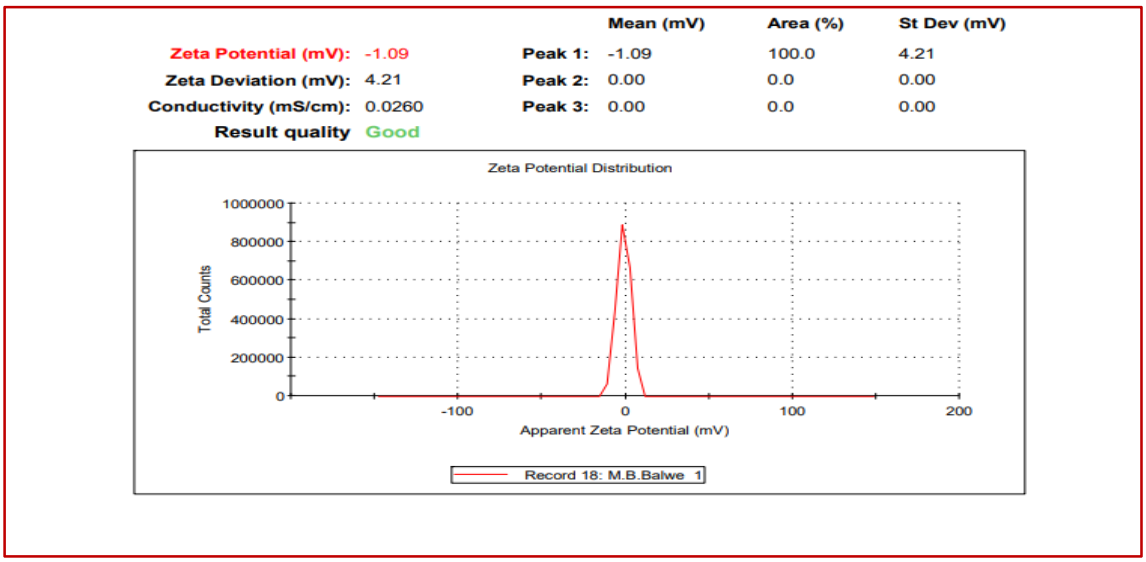


FIG 10: ZETA POTENTIAL OF NANOSPONGES.

***In vitro* drug release studies:**

In vitro drug release for Griseofulvin loaded nanosponges for a period of 12hrs was carried out by using 0.1N HCL at 37 ± 5^0C using cellophane membrane of 0.22nm. From the dissolution profile of formulations X1 to X8, it is concluded that formulation batch X5 shows better drug release profile than other formulations. Cumulative % release has been shown for average of three preparations. Cumulative % drug release for all the formulations are depicted in the table below.

TABLE 6:*IN- VITRO* DRUG RELEASE STUDIES OF DIFFERENT BATCHES OF NANOSPONGES

Time	% Drug release Nanosponges							
	1:0.5	1:1	1:1.5	1:2	1:0.5	1:1	1:1.5	1:2
1	8.38	7.71	5.81	6	12.56	13.17	11.04	10.04
2	18.22	16.78	14.44	15.21	21.23	24.09	18.42	16.42
3	25.83	29.53	24.37	28.02	31.25	33.47	27.79	25.79
4	32.02	37.18	32.66	34.82	39.6	42.64	35.27	33.27
5	46.33	44.04	39.98	44.64	49.97	51.83	41.38	39.38
6	56	58.07	53.09	54.72	59.97	58.58	49.9	48.9
7	67.96	69.59	59.18	62.05	68.54	66.36	55.69	57.69
8	72.07	74.21	69.07	70.76	76.17	71.16	63.55	68.55
9	77.67	79.81	74.64	76.33	81.77	76.09	68.21	70.21
10	83.14	85.29	80.1	81.8	87.26	82.99	74	77.43
11	86.45	88.62	83.4	81.8	90.61	82.99	80.8	84.8
12	93.5	88.62	86.32	81.8	95.59	82.99	80.8	90.8

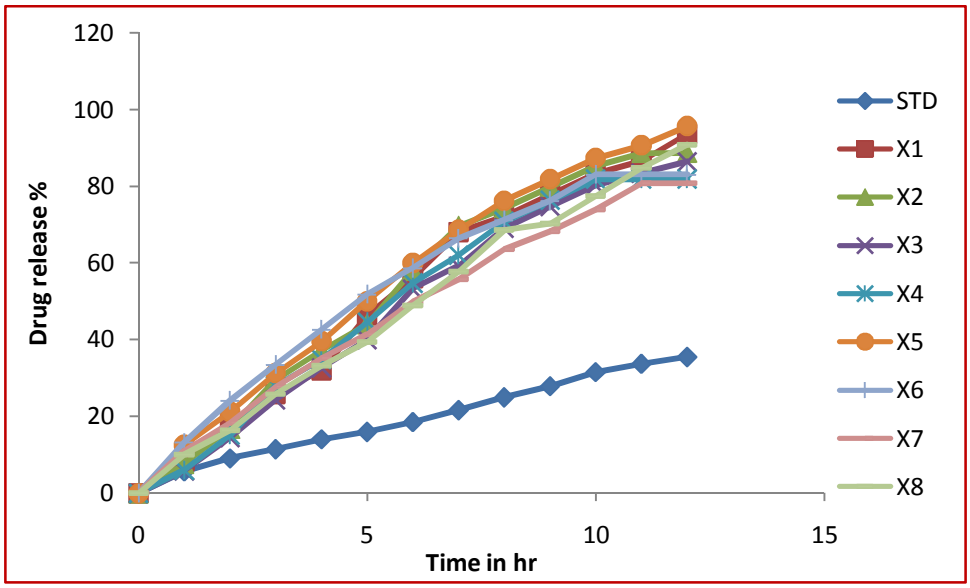


FIG 11: GRAPHICAL PRESENTATION OF COMPARATIVE DRUG RELEASE PROFILE FOR X1 TO X8 FORMULATIONS.

Zero order Kinetics

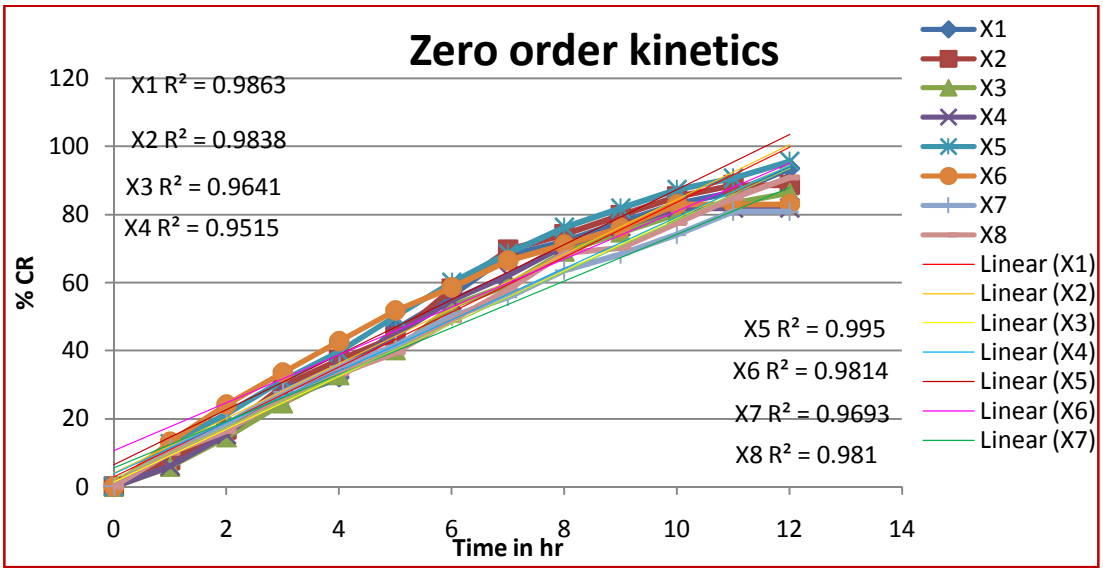


FIG 11 :(A) ZERO ORDER KINETICS

First order Kinetics

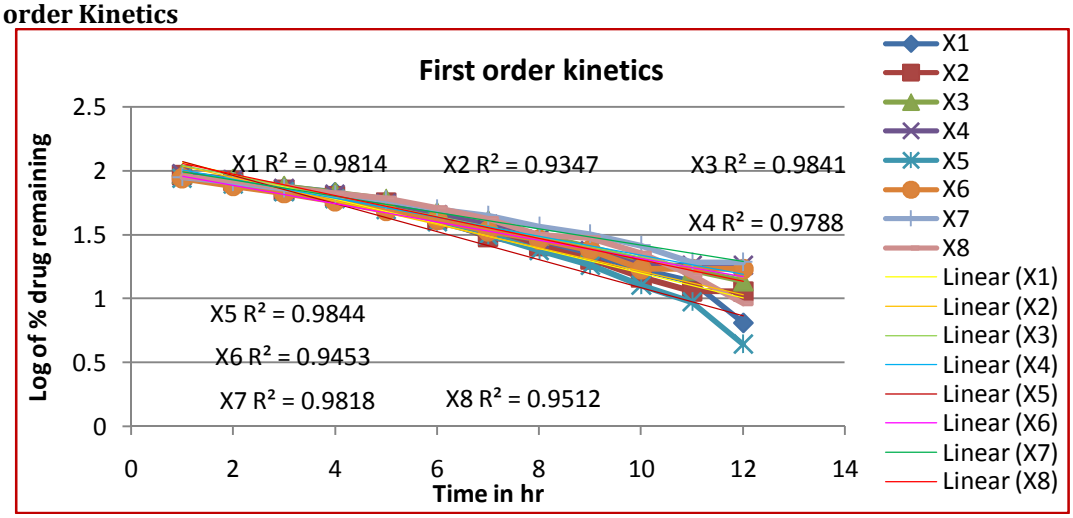


FIG 11: (B) FIRST ORDER KINETICS

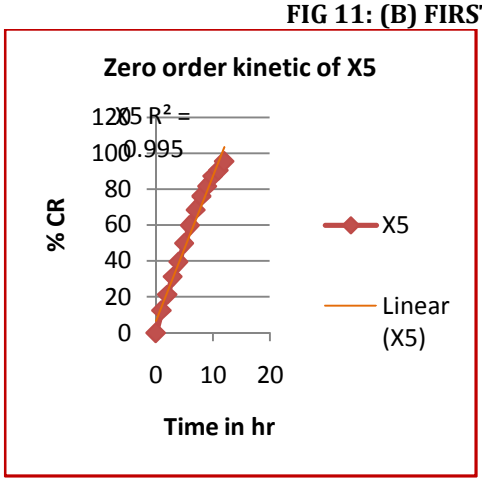


FIG 11:(C)ZERO ORDER KINETICS OF X5

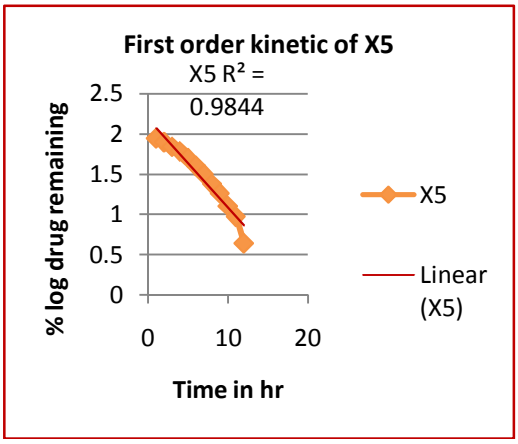


FIG 11: (D) FIRST ORDER KINETICS OF X5

R^2values of different release kinetic models:

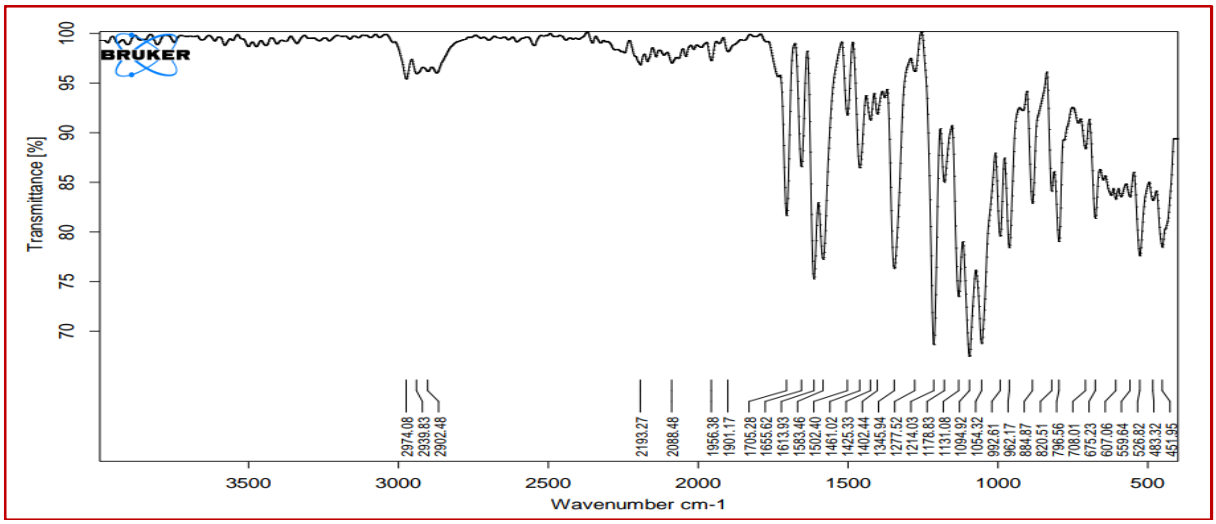
TABLE 7: REGRESSION COEFFICIENT (R^2) VALUE OF DIFFERENT KINETIC MODEL

Formulation	Zero order kinetics	First order kinetics
	R^2	R^2
X1	0.9863	0.9814
X2	0.9838	0.9347
X3	0.9641	0.9841
X4	0.9515	0.9788
X5	0.995	0.9844
X6	0.9814	0.9453
X7	0.9693	0.9818
X8	0.981	0.9512

EVALUATION OF OPTIMIZE FORMULATION:

Fourier-transform infrared analysis:

FT-IR spectra of Griseofulvin Nanosponges



FIR 12: FT-IR SPECTRA OF GRISEOFULVIN NANOSPONGES

Differential scanning calorimetry:
DSC Thermogram of Nanosponges

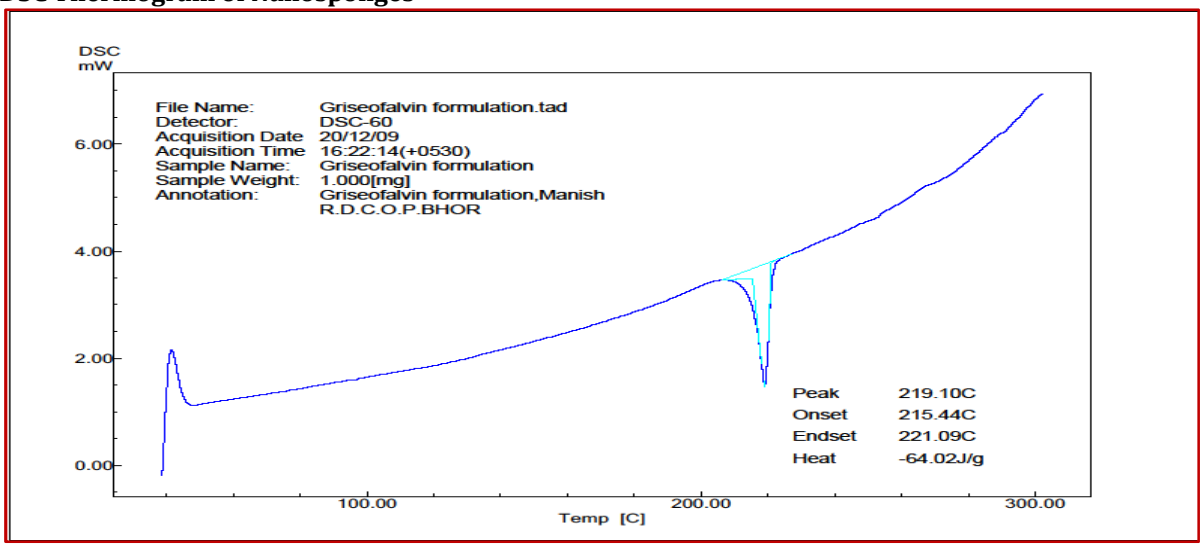


FIG 13: DSC THERMOGRAM OF NANOSPONGES

Powder x-ray diffraction studies

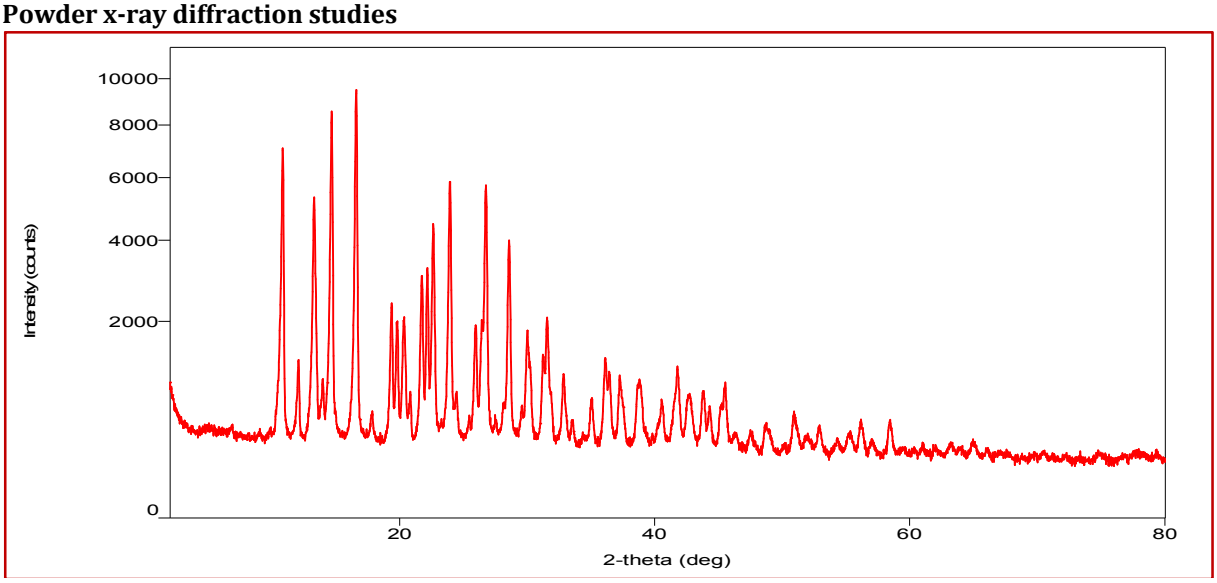


FIG 14: XRD PATTERNS OF GRISEOFULVIN

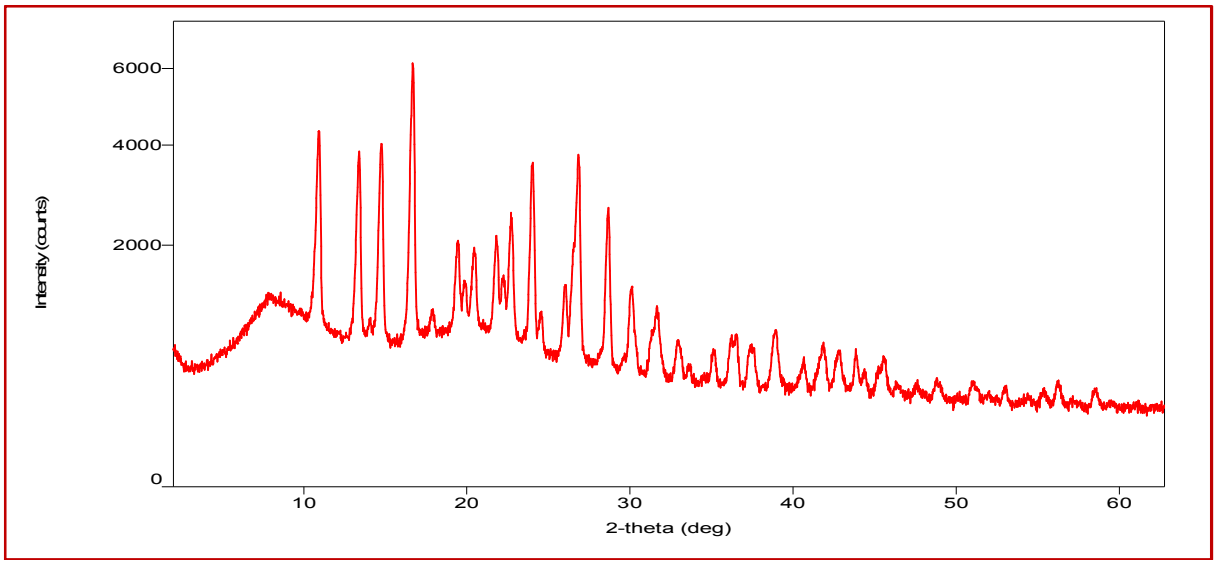


FIG 15: XRD PATTERNS OF NANOSPONGES

Scanning electron microscopy studies:

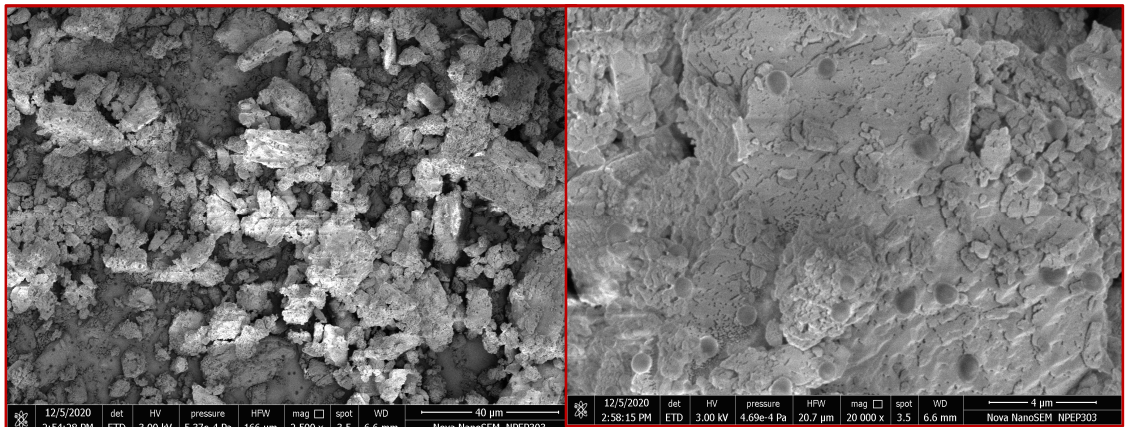


FIG 16: (A) SEM OF GRISEOFULVI **FIG 16:(B) SEM OF GRISEOFULVIN**

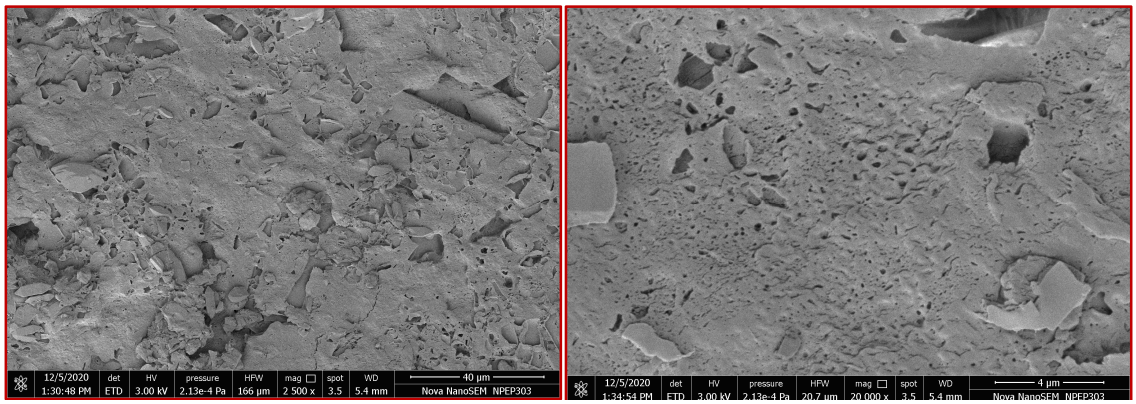


FIG 17: (A) SEM OF NANOSPONGE **FIG 17: (B) SEM OF NANOSPONGES**

Stability studies

Optimized formulation was subjected to stability studies as per ICH guidelines. Various parameters such as drug content, and *in vitro* drug release were measured before and after 30, 60, days of stability. Results of stability studies are shown in below table 8. Results of stability studies showed there is no significant change in the above mentioned parameter after elevated temperature and humidity conditions during stability studies. Thus, it can be proved from the stability studies that the prepared formulation is stable and not much affected by elevated humidity and temperature conditions Stability studies.

TABLE 8: STABILITY STUDIES OF FORMULATION.

Time(day)	Drug content (%)	In vitro drug release (%)
0	86.54 ± 0.13	95.59%
30	86.14 ± 0.73	95.29%
60	85.90 ± 0.29	95.01%

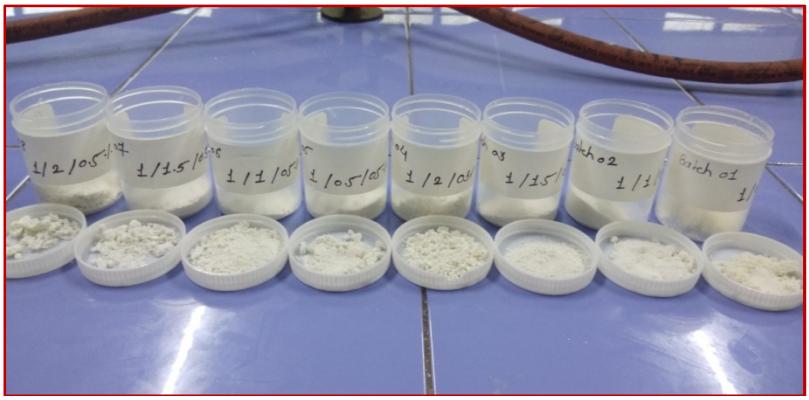


FIG 18 (A) PREPARE NANOSPONGE FORMULATIONS

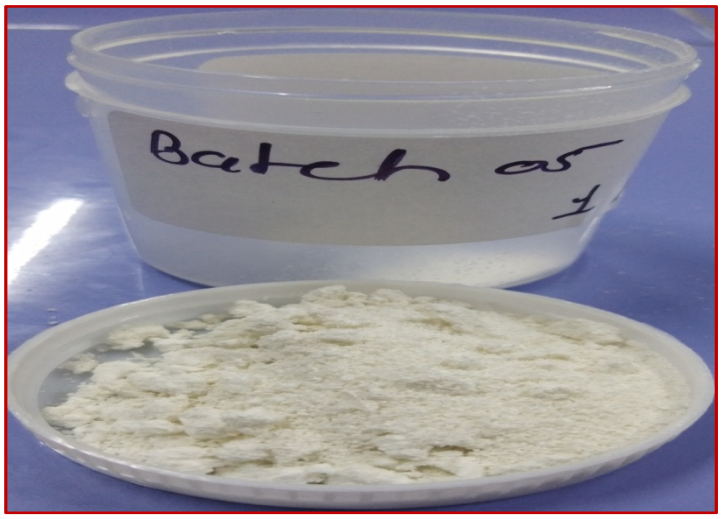


FIG 18 (B) PREPARE NANOSPONGE OF X5

DISCUSSION

The calibration curve of Griseofulvin in methanol and 0.1 N HCL by UV method showed the linearity in absorbance and coefficient of regression found to be respectively as 0.9993 and 0.9991. The IR studies shows that there is no interaction found between drug and excipients. All the characteristic peaks of griseofulvin were present in the spectrum of drug (fig. 3) and prepared Griseofulvin nanosponges (fig. 12), indicating compatibility in drug and polymer the spectrum confirmed that there is no significant change in the chemical integrity of the drug. The DSC thermogram pure griseofulvin shows sharp endothermic peak at 220˚C , which is its melting point as it melts with decomposition. Such a sharp endothermic peak indicates that griseofulvin used was in the pure crystalline state. The thermogram of prepared griseofulvin nanosponges 1:0.5 (fig. 13) displayed the nanosponge structure is amorphous as no sharp melting peak is shown.

The percentage yield of different batches was determined by weighing the nanosponges after drying. The percentage yields of different formulations were found to be in the range of 64±0.30 to 90±0.32%. The drug content and drug entrapment efficiency found in the range respectively as73.66±0.25 to86.54±0.13and 64.24±1.8 to 84.44±0.1. The increases concentration of polymer then the drug content and drug entrapment efficiency will also increases. The average Particle size and zeta potential was obtained in range respectively as340.12±2.52 nm to 535.73±2.66 nm and -16.4 mv to 8.12 mv. The Change in the concentration of polymer results variation in particle size and zeta potential of nanosponges. The average particle size of formulation batch X1 showed minimum particle size i.e.

340.12±2.52 nm while formulation batch X8 showed maximum particle size i.e. 535.73±2.66nm. The average zeta potential of formulation batch X1 showed minimum zeta potential i.e. -5.1mv while formulation batch X8 showed maximum zeta potential i.e. 8.12mv. If increase in the concentration of polymer then the increase in the zeta potential of nanosponges. The SEM of the prepared nanosponges showed a porous nature of griseofulvin nanosponges (fig. 17(a), 17(b)). Drug release data for the nanosponge formulat- ion fitted into zero order release kinetic and first order release kinetic equations to find out order of drug release. The various release kinetic curves are shown in fig. 11, 11A, 11B, 11C, 11D. The correlation coefficient showed that in the case of a zero order kinetic model, the release profile matched the zero-order drug release (R2=0.9950) from these results, it is obvious that the regression coefficient value is closer to unity. As plotted by the zero-order kinetic model, the data shows more linearity. Therefore, it can be inferred that the main drug release mechanism follows zero-order.

CONCLUSION

Nanosponge is the best modern novel sustain release drug delivery system. For increasing the solubility, dissolution and bioavailability profile of poorly water-soluble drug. BCS class-2 category drug are more suitable drug candidatefitt for formulated into nanosponges. Nanosponges are able to encapsulate variety of various types of drug molecules. Nanosponges prepared by using emulsion solvent diffusion method are simpler and production cost of method is less. The prepared nanosponge by using emulsion solvent diffusion method shows good drug content and entrapment efficiency ranged between 73.66±0.25 to 86.54±0.13 and 64.24±1.8 to 84.44±0.1. and optimum drug release is 95.59%. The compatibility of drug and polymer determine through FT-IR, and DSC study. The result of IR and DSC shows drug and polymer are compatible to each other and suitable to formulate into nanosponge. The nanosponge formulation shows zero order drug release. The outcome of the study concluded that Ethyl celluloce are employed as polymer for oral drug delivery system. Nanosponges of griseofulvin increases solubility and dissolution rate of drug. The emulsion solvent diffusion method is best method for preparation of nanosponges.

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