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FORMULATION AND EVALUATION OF MICROSPHERES OF NIFEDIPINE

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Abstract:

The aim of the study was to prepare Nifedipine microspheres using Solvent evaporation method using different polymer ratio. FT-IR studies revealed that there was no chemical interaction between the drug and polymer. The average particle size of the optimized formulation was found to be 166 µm. The in-vitro release behavior from all the Nifedipine microspheres was found to be peppas drug release kinetics and produced a sustained release over a period of 12 hours with better entrapment efficiency.

Key words: *Nifedipine, Eudragit, Carbopol 934p, HPMC, Solvent evaporation method and microspheres.*

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INTRODUCTION:

Oral route drug administration is by far the most preferable route for taking medications. However, their short circulating half life and restricted absorption via a defined segment of intestine limits the therapeutic potential of many drugs. Such a pharmacokinetic limitation leads in many cases to frequent dosing of medication to achieve therapeutic effect. Rational approach to enhance bioavailability aSnd improve pharmacokinetic and pharmacodynamics profile is to release the drug in a controlled manner and site specific manner. Microspheres are small spherical particles, with diameters 1 µm to 1000 µm. They are spherical free flowing particles consisting of proteins or synthetic polymers which are biodegradable in nature. There are two types of microspheres; microcapsules and micromatrices, which are described as, Microcapsules are those in which entrapped substance is distinctly surrounded by distinct capsule wall. and micromatrices in which entrapped substance is dispersed throughout the matrix. Microspheres are sometimes referred to as microparticles. Microspheres can be manufactured from various natural and synthetic materials. Microsphere play an important role to improve bioavailability of conventional drugs and minimizing side effects. Ideal characteristics of microspheres: [1,2,3,4,5]

Ideal characteristics of microspheres: [6]

- The ability to incorporate reasonably high concentrations of the drug.
- Stability of the preparation after synthesis with clinically acceptable shelf life.
- Controlled particle size and dispersability in aqueous vehicles for injection.
- Release of active reagent with a good control over a wide time scale.
- Biocompatibility with a controllable biodegradability.
- Susceptibility to chemical modification.

Advantages of microspheres:

- Particle size reduction for enhancing solubility of the poorly soluble drug.
- provide constant and prolonged therapeutic effect.
- provide constant drug concentration in blood there by increasing patent compliance,
- Decrease dose and toxicity.
- Protect the drug from enzymatic and photolytic cleavage hence found to be best for drug delivery of protein.
- Reduce the dosing frequency and thereby improve the patient compliance
- Better drug utilization will improve the bioavailability and reduce the incidence or intensity of adverse effects.
- Microsphere morphology allows a controllable variability in degradation and drug release.
- Convert liquid to solid form & to mask the bitter taste.
- Protects the GIT from irritant effects of the drug.
- Biodegradable microspheres have the advantage over large polymer implants in that they do not require surgical procedures for implantation and removal.
- Controlled release delivery biodegradable microspheres are used to control drug release rates thereby decreasing toxic side effects, and eliminating the inconvenience of repeated injections.

Limitation:

Some of the disadvantages were found to be as follows

- The costs of the materials and processing of the controlled release preparation, are substantially higher than those of standard formulations.
- The fate of polymer matrix and its effect on the environment.
- The fate of polymer additives such as plasticizers, stabilizers, antioxidants and fillers.
- Reproducibility is less.
- Process conditions like change in temperature, pH, solvent addition, and evaporation/agitation may influence the stability of core particles to be encapsulated.
- The environmental impact of the degradation products of the polymer matrix produced in response to heat, hydrolysis, oxidation, solar radiation or biological agents.

Types of microspheres:

- Bioadhesive microspheres
- Magnetic microspheres
- Floating microspheres
- Radioactive microspheres
- Polymeric microspheres
  i)Biodegradable polymeric microspheres
  ii)Synthetic polymeric microspheres

Bioadhesive microspheres: [7,8]

Adhesion can be defined as sticking of drug to the membrane by using the sticking property of the water soluble polymers. Adhesion of drug delivery device to the mucosal membrane such as buccal, ocular, rectal,

nasal etc. can be termed as bio adhesion. These kinds of microspheres exhibit a prolonged residence time at the site of application and causes intimate contact with the absorption site and produces better therapeutic action.

Magnetic microspheres: [9,10]

This kind of delivery system is very much important which localises the drug to the disease site. In this larger amount of freely circulating drug can be replaced by smaller amount of magnetically targeted drug. Magnetic carriers receive magnetic responses to a magnetic field from incorporated materials that are used for magnetic microspheres are chitosan, dextran etc. The different types of

a. Therapeutic magnetic microspheres used to deliver chemotherapeutic agent to liver tumour. Drugs like proteins and peptides can also be targeted through this system.

b. Diagnostic microspheres, used for imaging liver metastases and also can be used to distinguish bowel loops from other abdominal structures by forming nano size particles supramagnetic iron oxides.

Floating microspheres: [11,12,13]

In floating types the bulk density is less than the gastric fluid and so remains buoyant in stomach without affecting gastric emptying rate. The drug is released slowly at the desired rate, and the system is found to be floating on gastric content and increases gastric residence and increases fluctuation in plasma concentration. Moreover it also reduces chances of dose dumping. It produces prolonged therapeutic effect and therefore reduces dosing frequencies. Drug (ketoprofen) is given in the form of floating microspheres.

Radioactive microspheres: [14]

Radio embolization therapy microspheres sized 10-30 nm are of larger than the diameter of the capillaries and gets tapped in first capillary bed when they come across. They are injected in the arteries that leads them to tumour of interest so all these conditions radioactive microspheres deliver high radiation dose to the targeted areas without damaging the normal surrounding tissues. It differs from drug delivery system, as radio activity is not released from microspheres but acts from within a radioisotope typical distance and the different kinds of radioactive microspheres are α emitters, β emitters, γ emitters.

Polymeric microspheres:

The different types of polymeric microspheres can be classified as follows and they are biodegradable polymeric microspheres and Synthetic polymeric microspheres.

i) Biodegradable polymeric microspheres: [15]

Natural polymers such as starch are used with the concept that they are biodegradable, biocompatible, and also bio adhesive in nature. Biodegradable polymers prolongs the residence time when contact with mucous membrane due to its high degree of swelling property with aqueous medium , results gel formation. The rate and extent of drug release is controlled by concentration of polymer and the release pattern in a sustained manner. The main drawback is, in clinical use drug loading efficiency of biodegradable microspheres is complex and is difficult to control the drug release. However they provide wide range of application in microsphere based treatment.

ii) Synthetic polymeric microspheres: [16]

Synthetic polymeric microspheres are widely used in clinical application, moreover that also used as bulking agent, fillers, embolic particles, drug delivery vehicles etc. and proved to be safe and biocompatible but the main disadvantage of these kind of microspheres, are tend to migrate away from injection site and lead to potential risk, embolism and further organ damage.

MATERIALS AND METHODS:

Nifedipine-Provided by SURA LABS, Dilsukhnagar, Hyderabad, Eudragit-Central Institute of Fisheries Technology, Cochin, Carbopol 934p-Merk specialiities Pvt Limited, Mumbai, HPMC K4M-Chemical Drug House, New Delhi, Dichloromethane-Chemical Drug House, New Delhi

Methanol-Chemical Drug House, New Delhi, Sodium lauryl sulphate-Chemical Drug House, New Delhi.

METHODOLOGY:

PREPARATION OF 0.1N HCl (pH 1.2):

Take 8.5 ml of HCl in a 1000ml volumetric flask and make up the volume with distilled water

Preparation of Standard Calibration Curve of Nifedipine:

- ✓ 10 mg of Nifedipine was accurately weighed and dissolved in 10ml of methanol (Stock Solution – I) to get a concentration of 1000 µg/ml.
- ✓ From the stock solution-I, 1ml of aliquots was taken and suitably diluted with 0.1N HCl (Stock Solution-II) to get concentrations of 100µg/ml.
- ✓ From the stock solution-II, aliquots were taken and suitably diluted with 0.1N HCl (pH 1.2) to get concentrations in the range of 2 to 10µg/ml. The absorbance of these samples were analyzed by using UV-Visible Spectrophotometer at 231nm against reference solution 0.1N HCl (pH 1.2). The

procedure repeated to pH 6.8 phosphate buffer and pH 7.4 phosphate buffer.

Method of preparation:

Nifedipine microspheres were prepared using Eudragit, Carbopol 934p and HPMC K4M and distilled water as continuous phase by solvent evaporation technique. Initially dichloromethane (DCM) and methanol was mixed uniformly at room temperature, then Eudragit, Carbopol 934p and HPMC K4M in various proportions was dissolved in the above solution. To this mixture, a drug solution corresponding was added and mixed thoroughly and injected drop wise in to the continuous phase consisting of 100mL of 0.2% (w/v) SLS (Sodium Lauryl sulphate) at 250 rpm. The microspheres obtained was washed for 2-3 times with distilled water and dried at room temperature. Different concentrations and ratios of polymers used in the formulation of microspheres are mentioned in Table.

INGREDIENTS (MG)	FORMULATIONS								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Nifedipine	10	10	10	10	10	10	10	10	10
Eudragit	100	200	300	-	-	-	-	-	-
Carbopol 934p	-	-	-	100	200	300	-	-	-
HPMC K4M	-	-	-	-	-	-	100	200	300
Dichloromethane (mL)	20	20	20	20	20	20	20	20	20
Methanol (mL)	30	30	30	30	30	30	30	30	30
Sodium lauryl sulphate (mg)	25	25	25	25	25	25	25	25	25

RESULT AND DISCUSSION:

Preformulation studies:

Spectroscopic studies:

Determination of λmax:

A solution of 10µg/ml of Nifedipine was scanned in the range of 200 to 400nm. The drug exhibited a λ_{max} at 231 nm in simulated gastric fluid pH 1.2 and pH 7.4 phosphate buffer respectively. Correlation between the concentration and absorbance was found to be near to 0.998, with a slope of 0.028 and intercept of 0.004.

Calibration curve of Nifedipine in simulated gastric fluid pH 1.2:

Table 8.1 shows the calibration curve data of Nifedipine in simulated gastric fluid pH 1.2 at 231 nm Fig.8.1 shows the standard calibration curve with a regression value of 0.997, slope of 0.071 and intercept of 0.015 in simulated gastric fluid pH 1.2. The curve was found to be linear in the concentration range of 2-10µg/ml.

Table : Calibration curve data for Nifedipine in simulated gastric fluid pH 1.2

CONCENTRATION (µg /ml)	ABSORBANCE
0	0
2	0.167
4	0.306
6	0.459
8	0.579
10	0.718

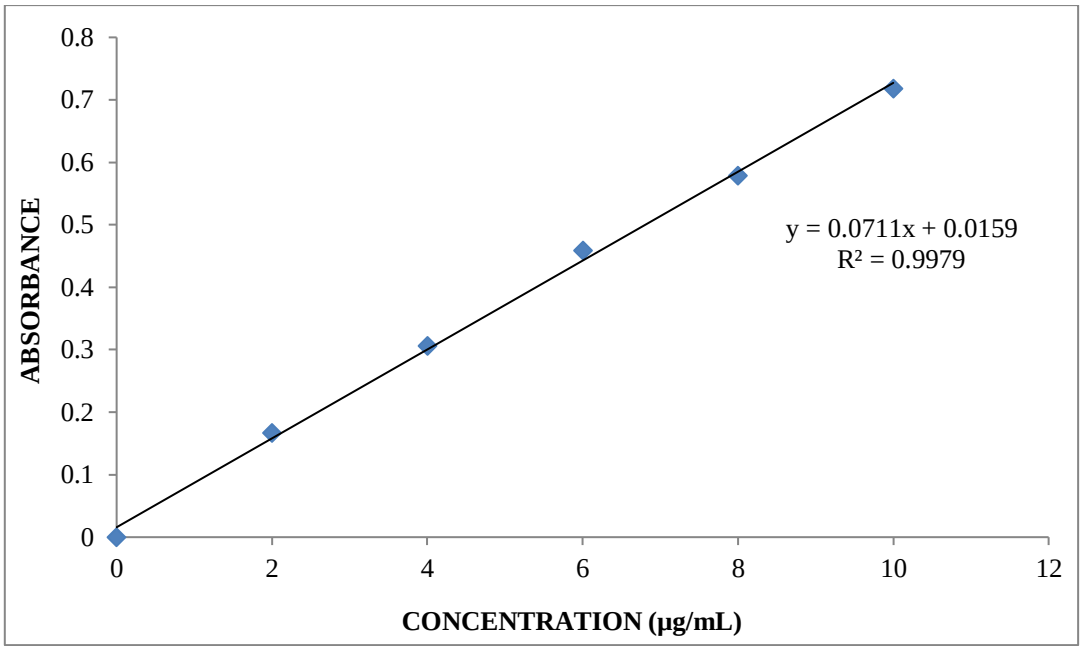

Figure : Standard graph Of Nifedipine in simulated gastric fluid pH 1.2

Calibration curve of Nifedipine in pH 7.4 phosphate buffer:

Table 8.2 shows the calibration curve data of Nifedipine in pH 7.4 phosphate buffer at 232nm. Fig. 8.2 shows the standard calibration curve with a regression value of 0.998, slope of 0.075 and intercept of 0.015 in simulated gastric fluid pH 1.2. The curve was found to be linear in the concentration range of 2-10µg/ml.

Table : Calibration curve data for Nifedipine in pH 7.4 phosphate buffer

CONCENTRATION (µg /ml)	ABSORBANCE
0	0
2	0.185
4	0.319
6	0.471
8	0.622
10	0.769

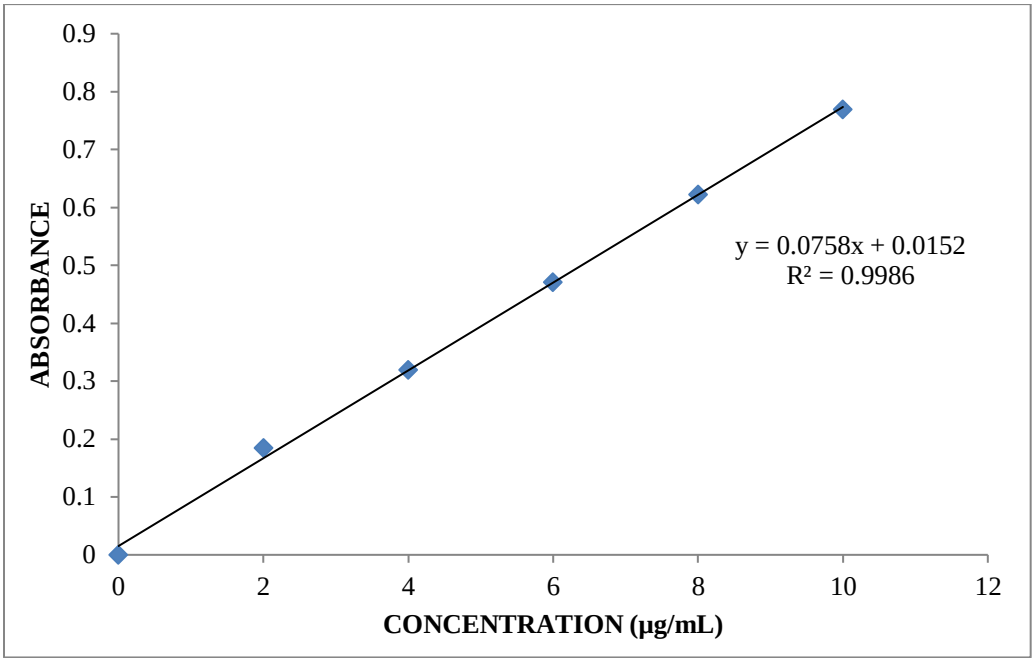

Figure : Standard graph of Nifedipine in pH 7.4 phosphate buffer

Evaluation and characterization of microspheres:
Micrometric Properties:

The mean size increased with increasing polymer concentration which is due to a significant optimum in the viscosity, thus leading to an increased droplet size and finally a higher microspheres size. Microspheres containing Eudragit as a polymer had a size range of 125±0.01 µm to 187±0.05 µm. Microspheres containing Carbopol 934p as polymer exhibited a size range between 137±0.08 µm to 191±0.09 µm.

Microspheres containing HPMC K4M as polymer exhibited a size range between 152±0.04 µm to 191±0.01µm.

The particle size data is presented in Tables 8.3 and displayed in Figures. The effect of drug to polymer ratio on particle size is displayed in Figure. The particle size as well as % drug entrapment efficiency of the microspheres increased with increase in the polymer concentration.

The bulk density of formulation F1 to F9 containing Eudragit, Carbopol 934p and HPMC K4M formulation was in the range of 0.50 to 0.59 gm./cm^3 (as shown in table 8.3), tapped density 0.50 to 0.59 and hausners ratio 1.135 to 1.237.

The carr's index of formulation F1 to F9 containing different grades of Eudragit, Carbopol 934p and HPMC K4M 11.86 to 19.18 respectively. The angle of repose of formulation F1 to F9 containing Eudragit, Carbopol 934p and HPMC formulation was in the range <31.45 respectively (as shown in table 8.3) The values of carr's index and angle of repose indicate good flow properties.

Table: Micromeritic property of microspheres of Nifedipine

Formulation code	Mean partical size	Bulk density (gm./cm^3)	Tapped density (gm./cm^3)	Hausener's ratio	Carr's index	Angle of repose
F1	125±0.01	0.59	0.73	1.237	19.18	31.45
F2	171±0.06	0.58	0.71	1.224	18.31	30.64
F3	187±0.05	0.58	0.70	1.207	17.14	30.05
F4	191±0.09	0.50	0.57	1.140	12.28	23.49
F5	166±0.02	0.52	0.59	1.135	11.86	23.82
F6	137±0.08	0.53	0.62	1.170	14.52	24.50
F7	152±0.04	0.55	0.64	1.164	14.06	24.68
F8	185±0.07	0.56	0.67	1.196	16.42	25.07
F9	191±0.01	0.54	0.65	1.194	16.40	25.05

Percentage yield:

It was observed that as the polymer ratio in the formulation increases, the product yield also increases. The low percentage yield in some formulations may be due to blocking of needle and wastage of the drug-polymer solution, adhesion of polymer solution to the magnetic bead and microspheres lost during the washing process. The percentage yield was found to be in the range.

Drug entrapment efficiency:

Percentage Drug entrapment efficiency of Nifedipine ranged from 72.90 to 90.45 % for microspheres containing Eudragit, Carbopol 934p and HPMC polymer, the drug entrapment efficiency of the prepared microspheres increased progressively with an increase in proportion of the respective polymers. Increase in the polymer concentration increases the viscosity of the dispersed phase. The particle size increases exponentially with viscosity. The higher viscosity of the polymer solution at the highest polymer concentration would be expected to decrease the diffusion of the drug into the external phase which would result in higher entrapment efficiency. The % drug entrapment efficiency of the prepared microspheres is displayed in Table 8.4, and displayed in Figures.

Table: Percentage yield and percentage drug entrapment efficiency of the prepared microspheres

Formulation code	% yield	Drug Content (mg)	% Drug entrapment efficiency
F1	96.25	96.14	72.90
F2	86.21	98.39	84.63
F3	90.14	98.50	90.25
F4	94.31	97.19	82.70
F5	97.35	99.24	89.12
F6	97.51	98.76	90.45
F7	87.64	95.81	82.63
F8	92.32	98.63	86.81
F9	94.14	97.58	89.69

Swelling studies:

The swelling ratio is expressed as the percentage of water in the hydrogel at any instant during swelling. Swell ability is an important characteristic as it affects mucoadhesion as well as drug release profiles of polymeric drug delivery systems. Swellability is an indicative parameter for rapid availability of drug solution for diffusion with greater flux. Swellability data revealed that amount of polymer plays an important role in solvent transfer. It can be concluded from the data shown in Table 8.5 that with an increase in polymer concentration, the percentage of swelling also increases. Thus we can say that amount of polymer directly affects the swelling ratio. As the polymer to drug ratio increased, the percentage of swelling increased from 12.33 to 34.26 % for microspheres containing Eudragit as polymer, 15.53 to 38.8 % for microspheres containing Carbopol 934p as polymer. The percentage of swelling of the prepared microspheres is displayed in Figures. The effect of drug to polymer ratio on percentage swelling is displayed in

Table : Swelling studies

S.NO.	FORMULATION CODE	INITIAL (Wt)	FINAL (Wt)	PERCENTAGE SWELLING
1	F1	15	16.85	12.33
2	F2	15	18.92	16.13
3	F3	15	20.14	34.26
4	F4	15	17.33	15.53
5	F5	15	18.24	21.6
6	F6	15	20.82	38.8
7	F7	15	23.41	56.06
8	F8	15	27.92	86.13
9	F9	15	26.34	85.61

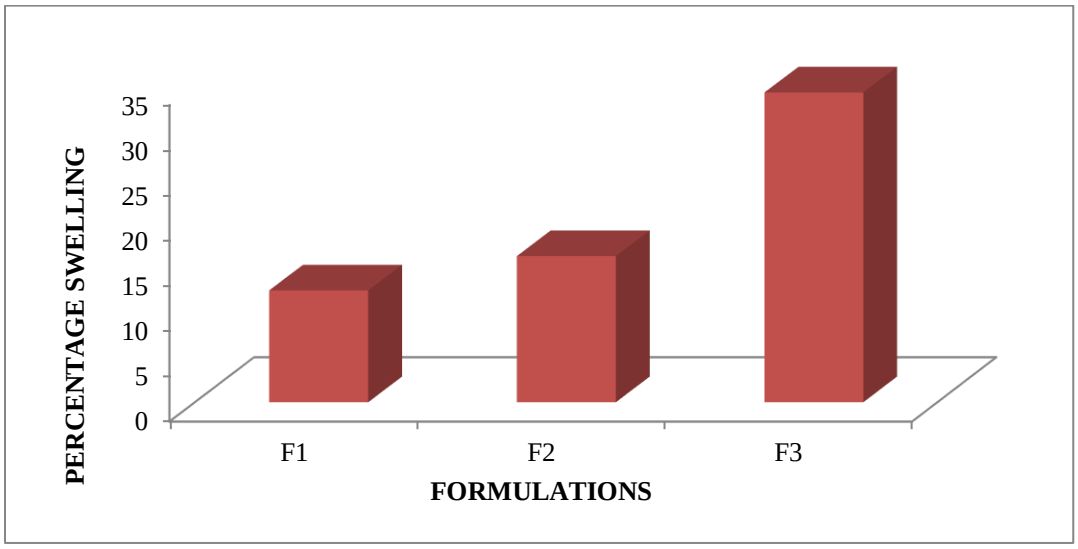

Figure : Percentage swelling of microspheres containing Eudragit

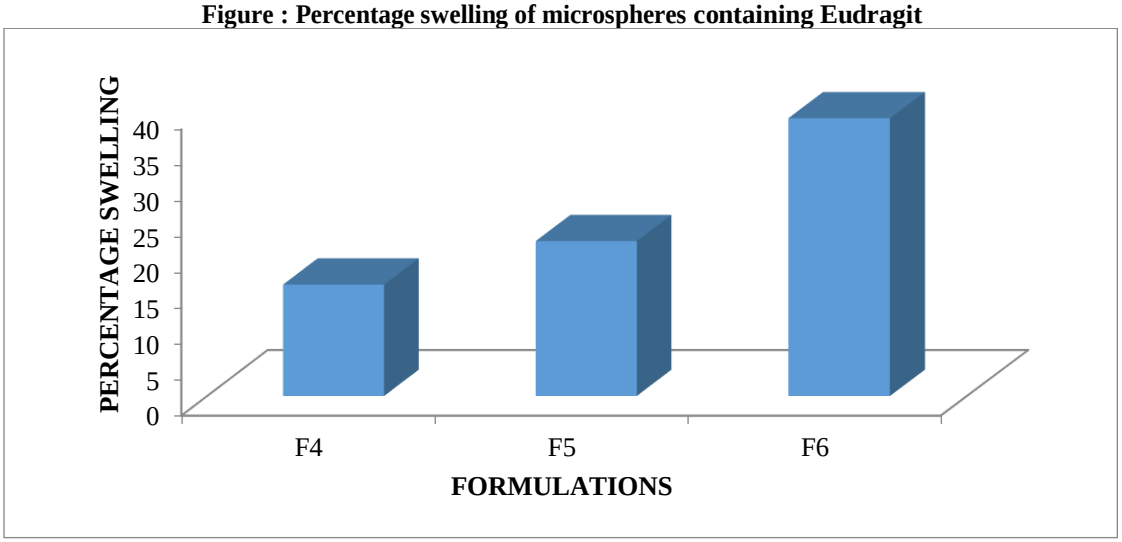

Figure : Percentage swelling of microspheres containing Carbopol 934p

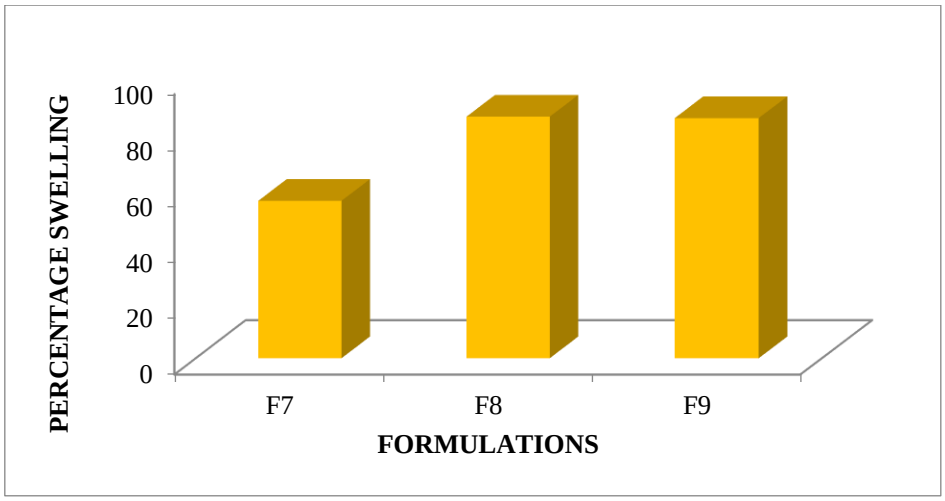

Figure: Percentage swelling of microspheres containing HPMC K4M

***In vitro* mucoadhesion test:**

As the polymer to drug ratio increased, microspheres containing Eudragit, Carbopol 934p and HPMC exhibited % mucoadhesion ranging from 72.75 to 96.25 %, the results of *in-vitro* mucoadhesion test are compiled in Table 8.6.

Table : *In Vitro* Mucoadhesion Test of all Formulations

S.NO.	FORMULATION CODE	No. OF MICROSPHERES		PERCENTAGE MUCOADHESION
		INITIAL	FINAL	
1	F1	20	14.55	72.75
2	F2	20	16.12	80.60
3	F3	20	18.14	90.7
4	F4	20	18.92	94.60
5	F5	20	19.25	96.25
6	F6	20	15.72	78.60
7	F7	20	17.32	86.6
8	F8	20	17.86	89.3
9	F9	20	17.89	90.01

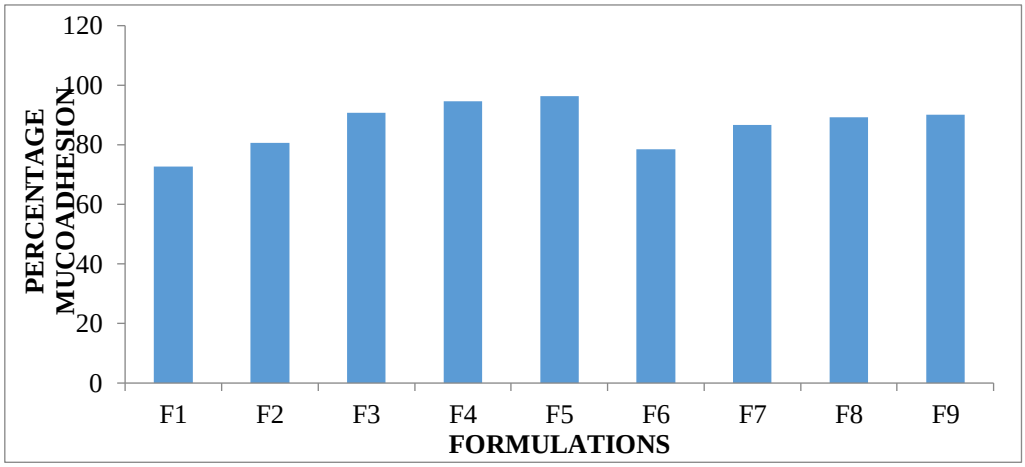

Figure : Percentage mucoadhesion of microspheres

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

Dissolution studies of all the formulations were carried out using dissolution apparatus USP type I. The dissolution studies were conducted by using dissolution media, pH 1.2. The results of the *in-vitro* dissolution studies of formulations F1 to F9 are shown in below table. The plots of Cumulative percentage drug release Vs Time.

The formulations F1, F2, and F3 containing Eudragit showed a maximum release of 79.70 % at 12 hours, 87.91 % after 12 hours, 91.53% 12 hours respectively.

The formulations F4, F5, and F6 containing Carbopol 934p showed a maximum release of 97.29 % at 12 hours, 99.72 % after 12 hours, 86.14% 12 hours respectively.

The formulations F7, F8, and F9 containing HPMC K4M polymer showed a maximum release of 80.15% 12 hours, 76.94 % after 12 hours, 73.04% after 12 hours respectively.

Table : *In-Vitro* drug release data of Nifedipine microspheres

TIME (h)	CUMULATIVE PERCENT OF DRUG RELEASED								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
0	0	0	0	0	0	0	0	0	0
1	12.85	15.75	10.57	12.62	7.82	10.12	15.34	12.31	10.02
2	17.36	20.11	16.31	17.17	13.29	16.72	21.51	17.42	15.36
3	25.17	28.90	20.69	25.34	18.34	21.63	29.86	25.69	23.61
4	30.28	34.71	26.14	32.23	23.71	27.72	35.11	31.34	30.65
5	34.20	40.67	31.52	37.60	27.62	31.34	39.82	36.29	34.92
6	41.63	45.29	37.43	42.57	35.78	37.21	43.51	41.14	40.52
7	47.71	53.75	45.92	47.82	41.83	42.26	49.22	45.28	42.95
8	52.89	59.97	53.21	56.71	56.90	46.33	53.32	56.95	51.82
9	57.40	62.76	60.82	62.22	63.14	52.82	57.81	61.24	56.74
10	65.71	67.34	79.29	77.99	79.57	67.34	61.12	67.32	62.58
11	68.43	74.82	86.32	89.18	86.25	72.21	75.23	71.41	69.25
12	79.30	87.91	91.53	97.29	99.72	86.14	80.15	76.94	73.04

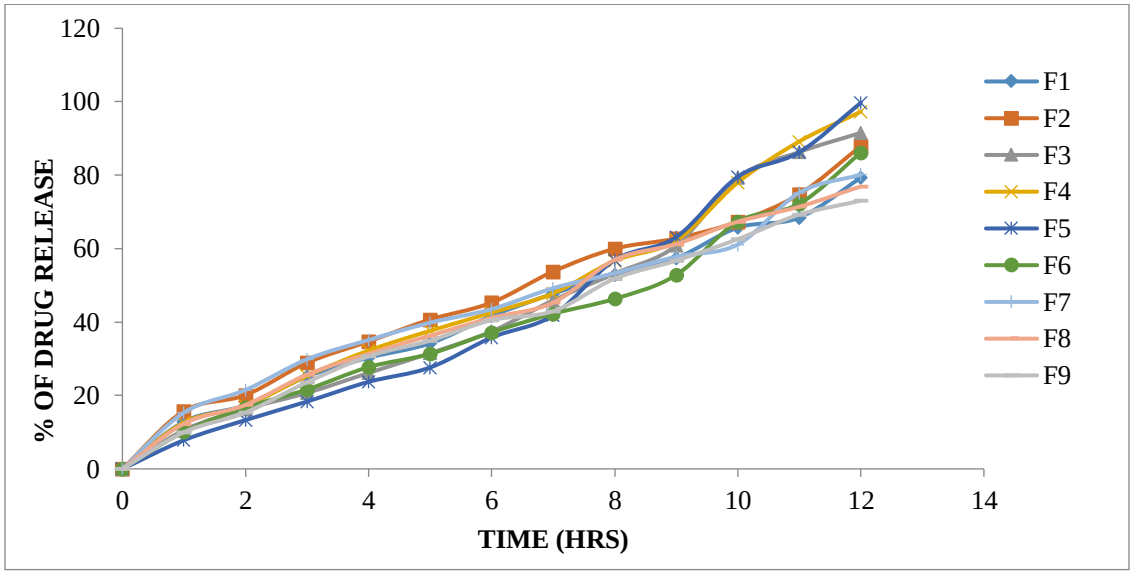

Figure : *In-Vitro* drug release profile of Nifedipine microspheres

Invitro drug release from all the formulation was found to be slow and sustained over the period of 12 hours, among other formulation F5 showed better sustained release pattern and the cumulative percentage release at the end of 12 hours was found to be 99.72 %.

***In-vitro* drug release kinetics**

For understanding the mechanism of drug release and release rate kinetics of the drug from dosage form, the *in-vitro* drug dissolution data obtained was fitted to various mathematical models such as zero order, First order, Higuchi matrix, and Krosmeyer-Peppas model. The values are compiled in Table 8.9. The coefficient of determination (R^2) was used as an indicator of the best fitting for each of the models considered. The kinetic data analysis of all the formulations reached higher coefficient of determination with the peppas release kinetics whereas release exponent value (n) ranged from 0.970. From the coefficient of determination and release exponent values, it can be suggested that the mechanism of drug release follows peppas release kinetics along with non-Fickian diffusion mechanism which leading to the conclusion that a release mechanism of drug followed combination of diffusion and spheres erosion.

TABLE : Release kinetics studies of the optimized formulation (F5)

CUMULATIVE (%) RELEASE Q	TIME (T)	ROOT (T)	LOG(%) RELEASE	LOG (T)	LOG (%) REMAIN	RELEASE RATE (CUMULATIVE % RELEASE / t)	1/CUM% RELEASE	PEPPAS log Q/100	% Drug Remaining	Q01/3	Qt1/3	Q01/3-Qt1/3
0	0	0			2.000				100	4.642	4.642	0.000
7.82	1	1.000	0.893	0.000	1.965	7.820	0.1279	-1.107	92.18	4.642	4.517	0.124
13.29	2	1.414	1.124	0.301	1.938	6.645	0.0752	-0.876	86.71	4.642	4.426	0.215
18.34	3	1.732	1.263	0.477	1.912	6.113	0.0545	-0.737	81.66	4.642	4.338	0.303
23.71	4	2.000	1.375	0.602	1.882	5.928	0.0422	-0.625	76.29	4.642	4.241	0.400
27.62	5	2.236	1.441	0.699	1.860	5.524	0.0362	-0.559	72.38	4.642	4.167	0.474
35.78	6	2.449	1.554	0.778	1.808	5.963	0.0279	-0.446	64.22	4.642	4.005	0.637
41.83	7	2.646	1.621	0.845	1.765	5.976	0.0239	-0.379	58.17	4.642	3.875	0.767
56.9	8	2.828	1.755	0.903	1.634	7.113	0.0176	-0.245	43.1	4.642	3.506	1.135
63.14	9	3.000	1.800	0.954	1.567	7.016	0.0158	-0.200	36.86	4.642	3.328	1.314
79.57	10	3.162	1.901	1.000	1.310	7.957	0.0126	-0.099	20.43	4.642	2.734	1.908
86.25	11	3.317	1.936	1.041	1.138	7.841	0.0116	-0.064	13.75	4.642	2.396	2.246
99.72	12	3.464	1.999	1.079	-0.553	8.310	0.0100	-0.001	0.28	4.642	0.654	3.987

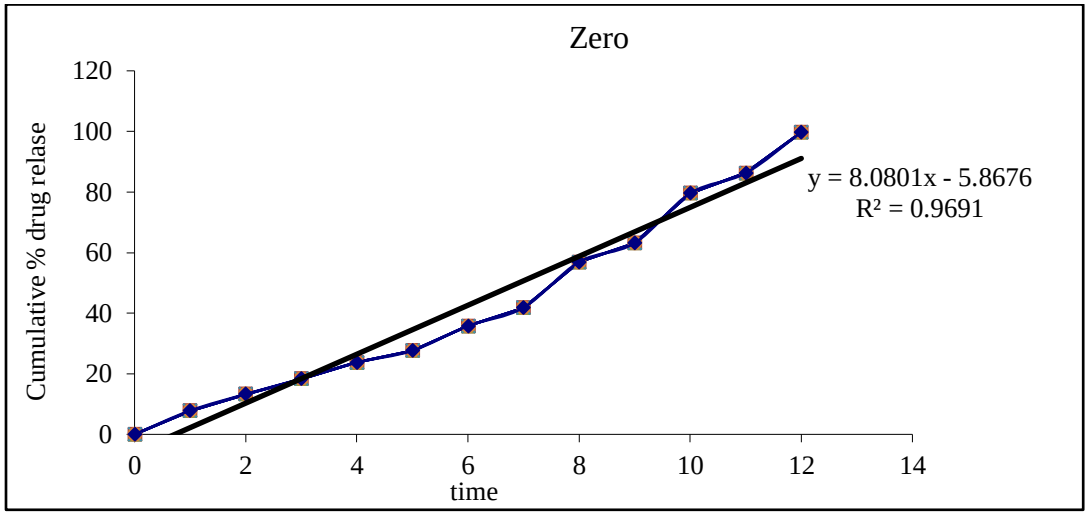

Figure: graph of zero order release kinetics of optimized formula

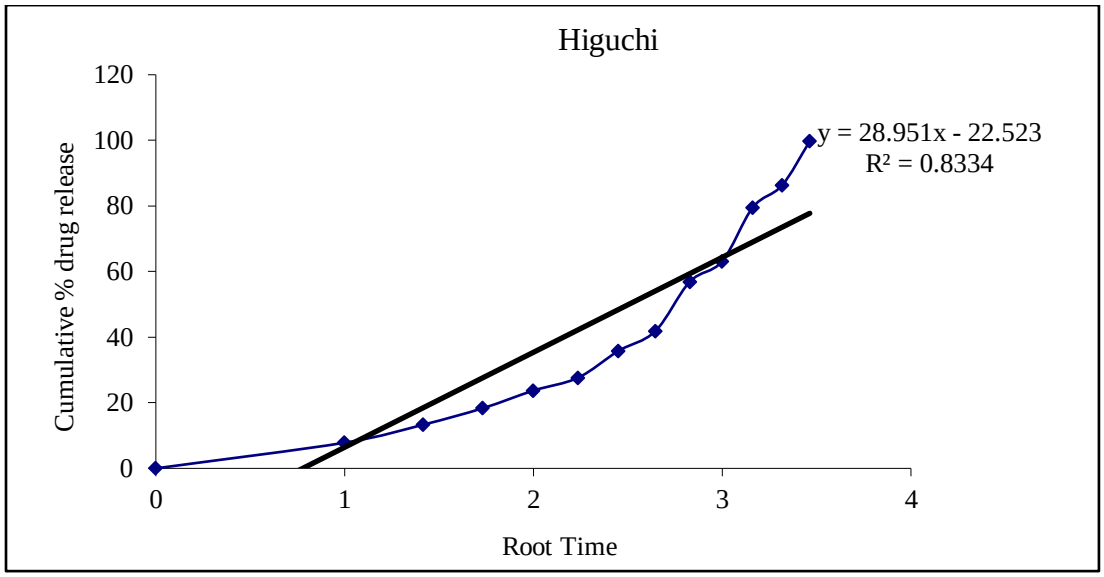

Figure: graph of higuchi release kinetics of optimized formula

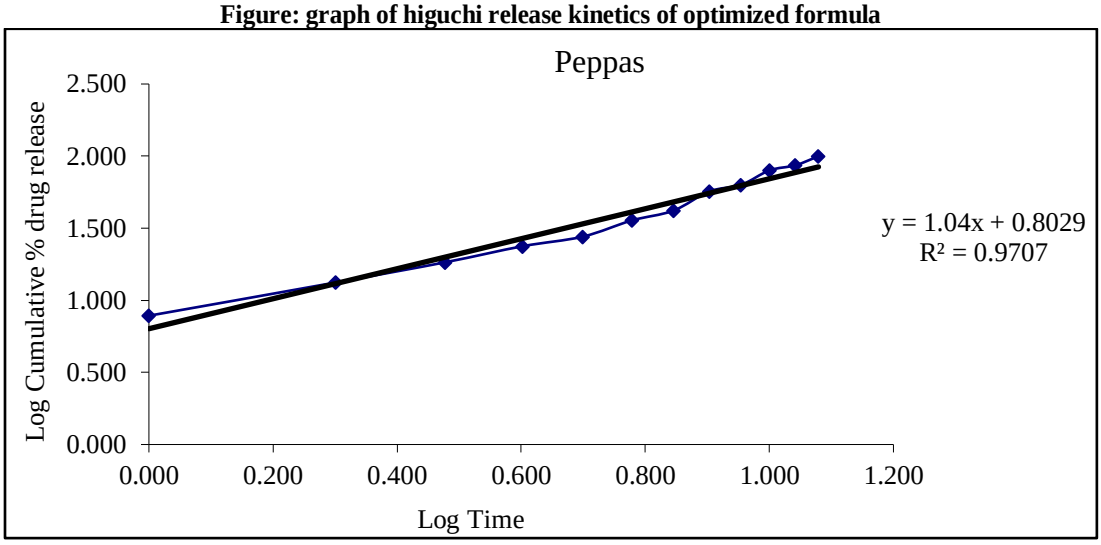

Figure : graph of peppas drug release kinetics of optimized formula

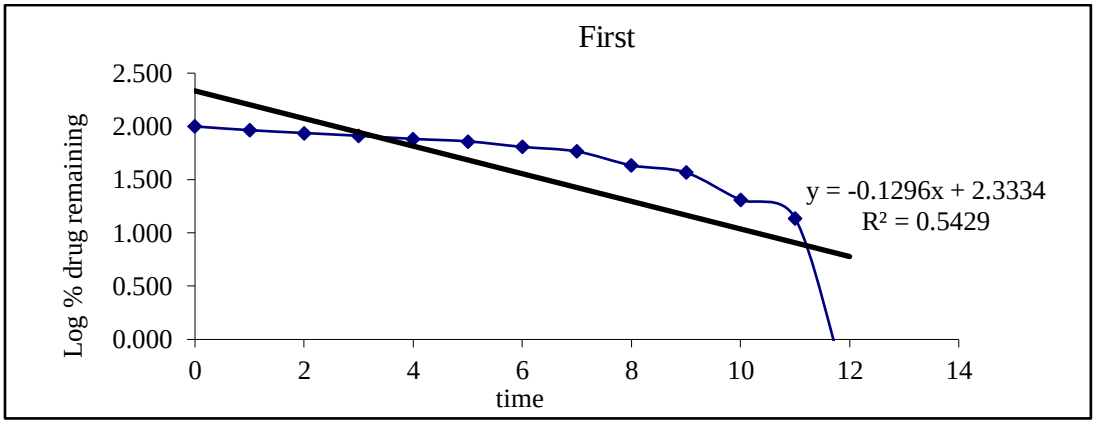

Figure: graph of first order release kinetics of optimized formula

Optimised formulation F5 was kept for release kinetic studies. From the above graphs it was evident that the formulation F5 was followed peppas drug release kinetics.

Compatibility studies:

Drug polymer compatibility studies were carried out using Fourier Transform Infra Red spectroscopy to establish any possible interaction of Drug with the polymers used in the formulation. The FT-IR spectra of the formulations were compared with the FTIR spectra of the pure drug.

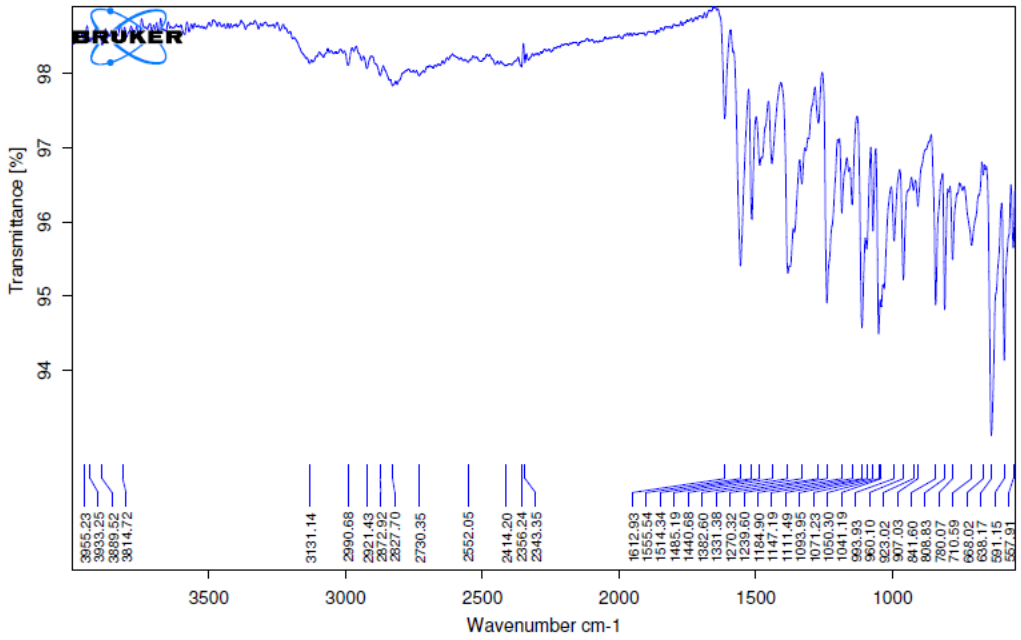

Figure : FT-IR spectra of Pure drug

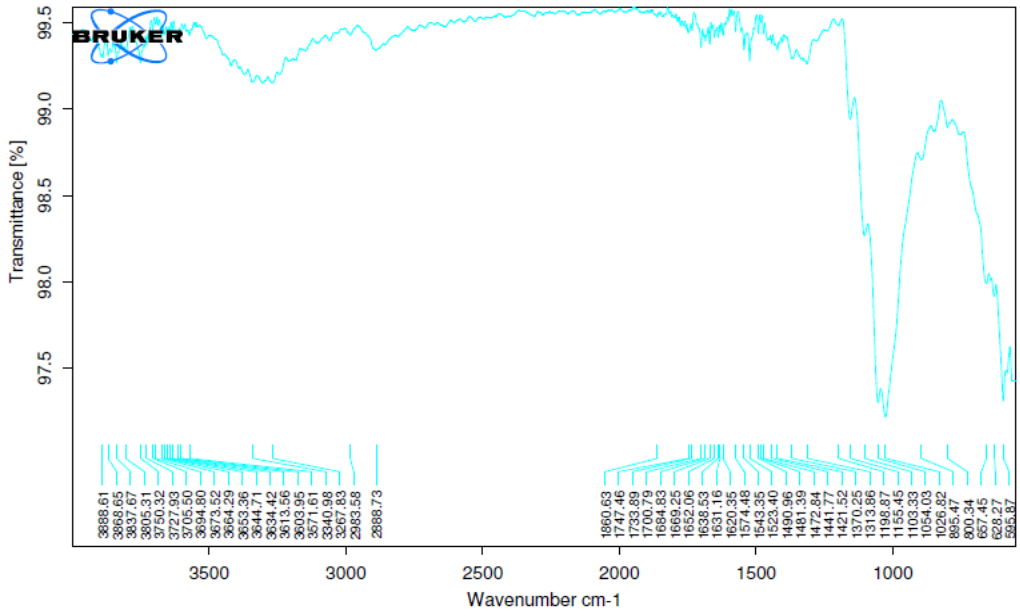

Figure : FT-IR spectra of Optimised formulation

SEM :

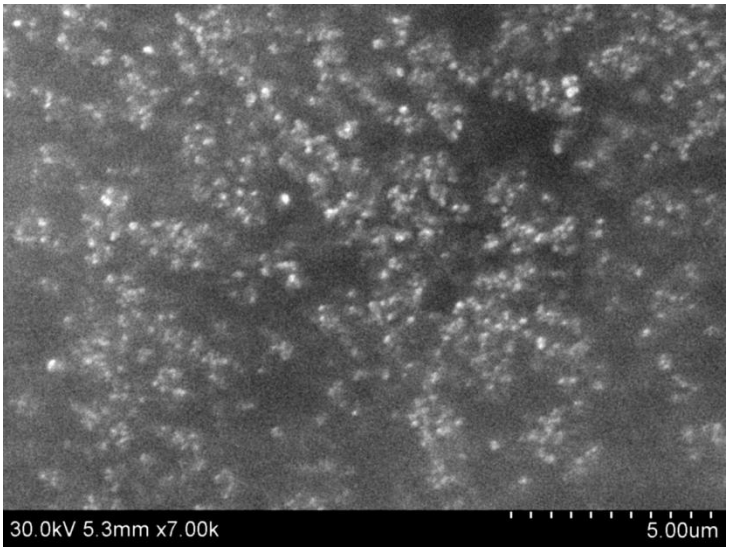

Figure : SEM of Optimised formulation

SUMMARY:

- An attempt was made to formulate Nifedipine loaded microspheres using Eudragit, Carbopol 934p and HPMC as a mucoadhesive polymer by Solvent evaporation method.
- In the present study F1to F9 formulations were prepared using Eudragit, Carbopol 934p and HPMC as a polymer (1:1, 1:2, and 1:3) in different ratios.
- The FTIR study was carried out for the drug, polymer, physical mixture and optimized formulation F5. In FTIR study, all characteristic peaks in the spectra appeared without any remarkable changes showing that there is no chemical interaction between the drug and polymer used in the preparation of microspheres.
- The mean particle size study was carried out by using microscopic analysis and found that the range for all formulations was varied from 125±0.01 to 191±0.09 µm due to change in drug and polymer ratio.
- The drug content for all the formulations was found to be in the range of 95.81 to 99.24 %. The formulation F5 had the highest drug content.
- The entrapment efficiency of all formulations was found to be in the range of 72.90 to 99.81 %.
- The *in vitro* mucoadhesion study was conducted for all the formulations and the results were found in the range of 73.05 to 99.72%.
- The *in vitro* drug release study was carried out for all the formulations and the formulation F5 (1:1) showed sustained release of 99.72% at the end of 12 h.
- The release rate followed peppas drug release kinetics.

CONCLUSION:

The aim of present study is to develop formulation of Nifedipine microspheres. Nifedipine microspheres were prepared through solvent evaporation technique. In the preliminary screening, from the FTIR spectra, it was observed that similar functional groups appear for the drug and the formulation. Hence it shows that there was no chemical interaction between drug and polymer used. The formulations F1 to F9 prepared by solvent evaporation technique. F5 Selected as an optimized formulation, because of better entrapment efficiency and *in vitro* drug release of about 99.72 % in 12hours. It follows peppas drug release kinetics. Hence it can be concluded that Nifedipine can be prepared in the form of microspheres by solvent evaporation technique to improve the drug targeting efficiency and also to prolong the duration of action.

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