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Formulation and Evaluation of Sustained Release Cefadroxil Microspheres by Inotropic Gelation Technique

JYOTSNA RANI SUDA*, G.V. RAMI REDDY, PALLAVI V, RAMARAO NADENDLA

Deparment of Pharmaceutics, Chalapathi institute of Pharmaceutical Sciences, Lam, Gorantla, Guntur-5222034, AndhraPradesh, India.
Corresponding author address: jyothemighty@gmail.com Deparment of Pharmaceutics, Chalapathi institute of Pharmaceutical Sciences, Lam, Gorantla, Guntur-5222034, AndhraPradesh, India.

Abstract
The aim of the present study was to overcome the drug-related adverse effects like gastric irritation, and improve its bioavailability in different gastrointestinal pH conditions. Total nine formulation batches (F1-F9) were formulated using sodium alginate alone and combination with HPMC K100M, and Metolose SR polymer as drug release modifiers in various proportions and investigated for physicochemical properties and drug release potential. All investigated properties showed satisfactory results. Increase in the concentration of sodium alginate and other polymer dispersions increased sphericity, size distribution, flow properties and mean diameter of the Microspheres. The drug entrapment efficiency was obtained in the range of 70.4% to 94.2%. Increase in the concentration of calcium chloride was significantly affects the mean diameter but no appreciable change in morphology and drug release behaviour. In-vitro study proved that drug release was slowly increased as the pH of the medium was increased. The drug release in batch F1, F2 and F3 showed more faster release than F7,F8, F9 but optimum sustained release was observed in the formulation F9 containing sodium alginate and HPMC K100M. The mechanism ofdrug release from Microspheres was found to be following Case-II transport. From the study it was concluded that controlled release Cefadroxil Microspheres can be developed successfully by using ionotropic gelation technique.

Keywords: *Microencapsulation; Ionotropic gelation; Microspheres; Sodium alginate; HPMC K100M.*

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I. INTRODUCTION:

Sustained dug release systems, which achieves slow release of drug over an extended period of time. In sustained release dosage forms, a sufficient amount of drug is initially made available to the body to cause a desired pharmacological response. The remaining fraction is released periodically and is required to maintain the maximum initial pharmacological activity for some desirable period of time expected from usual single dose. A sustained release is facilitated through the consistent rejuvenation of drug molecules1.

Microencapsulation is a process by which solids, liquids or even gases may be enclosed in microscopic particles formation of thin coatings of wall material around the substances. There are various approaches in delivering a therapeutic substance to the target site in a sustained release fashion. One such approach is using microspheres as carriers for drugs[2]. Microspheres can be defined as solid, approximately spherical particles ranging in size from 1to1000μm[3] .They are made of polymeric, waxy or other protective materials that are biodegradable synthetic polymers and modified natural products such as starches, gums, proteins, fats and waxes. The natural polymers include albumin and gelatin, the synthetic polymer include polylactic acid and polyglycolic acid[4]. The solvents used to dissolve the polymeric materials are chosen according to the polymer and drug solubility and stability,process safety and economic considerations. Microspheres are small and have large surface-volume ratio.At the lower end of their size range they have colloidal properties.The interfacial properties of microspheres are extremely important, often indicating their activity[5].

II. METERIALS:

Cefadroxile and HPMC K 100M was obtained from spectrum Lab Hyderabad, Sodium alginate, Metolose SR was obtained from S.D.Fine Chem Ltd,Mumbai.

Preparation of Microspheres:

Microspheres of Cefadroxil were prepared by Ionotropic gelation technique. In the present work four sets of Microspheres were prepared by using sodium alginate alone in different concentrations and with different concentrations of coating polymers like HPMC K100M, Metolose SR,andCalcium chloride as counter ion.

Preparation of Sodium alginate Microspheres:-

In the first set three batches of drug-loaded Microspheres were prepared (F1, F2,F3).A solution of sodiumalginate (2-4%w/v) was prepared in 100ml of deionized water. In 50ml of sodiumalginate solution,weighed quantity of Cefadroxil sodium was dispersed uniformly. Bubble free dispersion was dropped through as syringe in to 100ml aqueous calcium chloride solution and stirred at 100rpm. After stirring for 10minutes, the obtained spheres were separated by filtration washed with distilled water, and dried at 60°C for 6hrs in a hot air oven.

Preparation of Alginate Metolose SR Microspheres:-

In the second set of batches of drug-loaded Microspheres were prepared (F4,F5,F6) using sodium alginate and Metolose as sustained release coating polymer. To 50 ml of deionized water, metolose sr (0.5 – 1% w/v) were added and stirred with the electric stirrer to form mucilage. Then sodium alginate (3%w/v) was added to form uniform mucilage. Then finely weighed quantity Cefadroxil was added and homogenized for 5min.The resulting dispersion was dropped through syringe in to 100ml of 5%w/v aqueous calcium chloride solution and stirred at 100rpm .After stirring for 10minutes the formed spheres were separated, and washed with distilled water, and dried at 60°C for 6 hr.

Preparation of Alginate-HPMC K100M Microspheres:-

In the third set, three batches of Microspheres were prepared (F7,F8,F9) using sodium alginate and HPMC K100M as a coating polymer.To50ml of aqueous sodium alginate solution, weighed quantity Cefadroxil was dispersed uniformly. Bubble free dispersion was dropped through a syringe in to 100ml of HPMC K100M solution containing5% w/v calcium chloride (HPMCK100M dissolvedin10ml of 5% w/v acetic acid),was rotated at 100rpm. After stirring for 30minutes the coated spheres were separated by filtration, washed with distilled water, and dried at 60°C for 6 hr.

Preparation of Alginate-Calcium chloride Microspheres:-

Formulations F7, F8, F9 were prepared by using sodium alginate and Calcium chloride as a polymers. These Microspheres were prepared as described above same as alginate-CMC Microspheres.

III. EVALUATION OF MICROSPHERES:

Measurement of micromeritic properties of microspheres:

Granulometric Study:-

. Granulometric study was conducted to determine the particle size distribution pattern. For this study sieve analysis was carried out on mechanical sieve shaker, using different meshes (#12, #16, #22, #30) of American Society of Testing Materials (ASTM). Distribution of Microspheres is reported in table[6]

FlowProperty:-

The angle of repose of microspheres was determined by using fixed-base cone method to assess the flowability. The fixed-base cone method, a funnel was secured with it tip at a1cm height (H) above the graph paper that was placed on a flat horizontal surface. Microspheres were carefully poured through the funnel until the apex of the conical pile just touched the tip of the funnel. Measured the height and the radius of the base with ruler.[7]

Bulk and Tapped Density:-

The bulk and tapped densities were measured in a 10ml graduated measuring cylinder.. The sample contained in the measuring cylinder was tapped mechanically by means of constant velocity rotating cam with change in its initial bulk density to a final tapped density when it has attained its most stable form. Each experiment was carried out in triplicate. The bulk and tapped density can be determined[8]

Surface morphological study:

The surface morphological details of the Microspheres were determined by using a scanning electron microscope (SEM) model JSM, 35CF JEOL, Japan.

The samples were dried thoroughly in a vacuum desicator before mounting on brass specimen studies. The samples were mounted on specimen using double sided adhesive tape, and gold-palladium alloy was coated on the sample using spatter coating unit (Model E5100 Polaron, UK) in an argon ambient of 8-10 pascal with plasma voltage about 2Kv and discharge current about 20mA. The sputtering was done for nearly 3minutes to

obtain uniform coating on the samples to enable good quality of SEM images. The SEM was operated at low accelerating voltage of about15Kv with load current of about 80mA. The condenser lens position was maintained between 4.4 – 5.1. The objective lens aperture has a diameter of 240 micron sand
the working distance WD = 39mm[9].

Loose-Surface Crystal Study:
In this study accurately weighed 25mg of microspheres (#16) was suspended in the phosphate buffer pH 7.4 and was shaken vigorously for 5min. The drug leached out from the surface of the micropellets was analyzed at 260nm wavelength spectrophotometrically.[10]

Swelling Properties:
The swelling properties of prepared microspheres were determined in acidic buffer pH1.2.Thirty dried spheres were placed in a beaker to which 200ml of buffer solution was added and then stirred with a magnetic stirrer at 50 rpm. After 1hr interval the swollen spheres were observed and measured under optical microscope. The magnitude of swelling was presented by the ratio of the mean diameter of swollen spheres to the mean diameter of the dried spheres before the test[11].

Drug Entrapment Efficiency (DEE):
Drug entrapment efficiency of microspheres was performed by accurately weighed 50mg of Microspheres were suspended in 100ml of phosphate buffer pH 7.4. The resulting solution was kept for 24hours. Next day it was stirred for15 min and subjected for filtration. After suitable dilution, Cefadroxile content was determined by using Shimadzu1201UV-visible spectrophotometer at 260 nm.[12] The obtained absorbance was plotted on the standard curve to get the exact concentration of the entrapped drug. Calculating this concentration with dilution factor we get the percentage of actual drug encapsulated in Microspheres.
The drug entrapment efficiency was determined using following relationship:-
%DEE = Actual drug content/theoretical drug content×100

***In-Vitro* Dissolution Studies**
The method is specified in USP for drug release study was followed:-
Apparatus:-USPXIII dissolution rate test apparatus employing the round bottom dissolution vessel and rotating basket assembly.
Acid stage:- 900ml of simulated gastric fluid TS (acid buffer pH1.2 without enzymes).
Buffer stage:-900ml of pH6.8 and simulated intestinal fluid TS (phosphate buffer pH 7.4 without enzymes).[12]

Kinetic Treatment:
The data obtained from the *in-vitro* dissolution studies subjected for kinetic treatment[14] to obtain the order of release and best fit model for the formulations by using pcp-disso-V2 software.

Preparations of capsules:
Hard gelatin capsules were filled with microspheres equivalent to500mg of Cefadroxil and were evaluated for in-vitro dissolution studies. The study was carried out in a USPXIII rotating basket apparatus. Dissolution fluid consists of 900ml of simulated gastrointestinal fluid of increasing pH namely pH1.2(2hr), pH6.8 (1hr) and pH7.4 (upto10 hrs) maintained temperature at 37°C± 0.5°C and the basket was rotated at a constant speed of 50rpm. Aliquots were withdrawn at predetermined periods of time and the same volume of fresh medium was added immediately to the test medium. The withdrawal samples were filtered through 0.45µm membrane filter. The drug content was determined in the filtrate after appropriate dilution and analyzed at260nm spectrophotometrically using Shimadzu 1201UV-visible spectrophotometer. Corresponding concentrations in the samples were calculated from standard plot and calculated cumulative percentage of drug release from each formulations.

IV. Results:

EVALUATIONOF MICROSPHERES:

In the present work Cefadroxil Microspheres were prepared by ionotropic gelation technique using sodium alginate and also with three different coating polymers. Total nine batches of microspheres (F1-F9) were prepared and investigate the physico-chemical properties like granulometric study, flow properties,particlesize,drug-entrapment efficiency,swelling properties, scanning electron microscopy, loose-surface crystal study and in-vitro drug release behaviors.

Granulometric Study:

The size distribution of the Microspheres in different sieves were observed, that about 42.46% to 79.50% of microspheres were retained in #20 sieve,which proves the uniformity size of Microspheres. It was observed that by decreasing the concentration of sodium alginate and $CaCl_2$ solution spherical microspheres. were not formed However increase in the concentration of sodium alginate and calcium chloride

solution tend to make the particles more spherical and obtaining the uniform size spheres. On other hand with increase in the concentration of coating polymers in the formulated microspheres of batch F1,F2,F3 (Sodium alginate) F4,F5,F6 (MetoloseSr), F7,F8,F9 (HPMC K100M) it was observed that the distribution of the particle size slightly shifts to the lower pore size due to increase in the physical behaviour of the microspheres.

Flow Property:

The flow property of the prepared formulations were determined by measuring the angle of repose using fixed-base conemethod. All the formulations showed an acceptable range of angle of repose The batches prepared with coating polymers such as Metolosesr (F4, F5, F6 and HPMC K100M (F7,F8,F9) showed good flow ability compared with batches F1, F2F3. It indicates that the presence of the coating polymers will also affects the flow property of Microspheres. Bulk and tapped density of the Microspheres also determined in a 10ml measuring cylinder. All the formulations show good acceptable range and found to have higher pack ability.

Particle Size:

Particle size of drug-loaded Microspheres was performed by optical microscopy.The size of the spheres were obtained in the range 1 to1000µm.The mean diameter of the particles were found to decrease by increasing in the concentration of calciumchloride solution and also increasing in the concentration of sodium alginate by increase in the diameter of the particles.The mean diameter of the Microspheres were reported in table

It has been stated that when adrop of alginat solution comes in contact with calcium ions, gelation occurs instantaneously. AsCa^{+2} ions, penetrates in to interior of droplets, water is squeezed out of the interior of droplets resulting in contraction ofthe spheres. Thus increase in concentration of calcium chloride solution will significantly affect the contraction of the spheres leading to decrease in diameter.

On other hand at fixed concentration of sodium alginate and calcium chloride in the formulation batches F4,F5,F6,F7,F8 and F9 (3%sodium alginate and5%calcium chloride) and increases in the coating polymer concentration leading to increase in the diameter of formed Microspheres.

Scanning Electron Microscopy:

The physical parameters like shape and particle size were analyzed by scanning electronmicroscopes, which were presented for determining the surface and size, in the photographs1to 4. The SEM's of the formulation F2, F5, F7 and F9 showed that the spheres are having the size-range with in the standard limits.

The SEM of the Microspherespreparedfrom sodium alginate alone (F2) are spherical in shape, exhibits uniformity and rough surface has a sandy appearance, however in case drugloaded sodium alginate Microspheres containing coating polymers like MetoloseSr (F5), HPMC K100M(F9) appeared to be spherical, although the surface was not smooth as sodium alginate Microspheres. This was due to coalescence and fusion to the colloidal aqueous polymer dispersions in the alginate matrix. The average diameter of the particles increases and decrease the porosity accounts for slow release of drug. From the photo micrographic observation it can be stated that bridging and dense nature of the formulation From the photo micro graphic observation it can be stated that bridging and densenature of the formulation batches F5andF7 were significantly prolong the drug release compared with other formulation batches

V. Conclusion:

The experimental result of the prepared cefdroxile microspher the results of the prepared cefadroxile microsphers, the result sugegest that microspheres containing anti –biotic agent cefdroxile were successfully formulated by an ionotropic gelation technique by using sodium alginate, HPMC K100 and metolose SR as polymers and calcium chloride as cross linking agent to produce sustained release delivery system By increase in the percentage of polymer concentration has significantly affected on the size of spheres and the optimum release of cefadroxile from the microsphears which showed formulation F9 is 89.89 of drug released respectively with in 12hrs.

AKNOLEGDEMENT:

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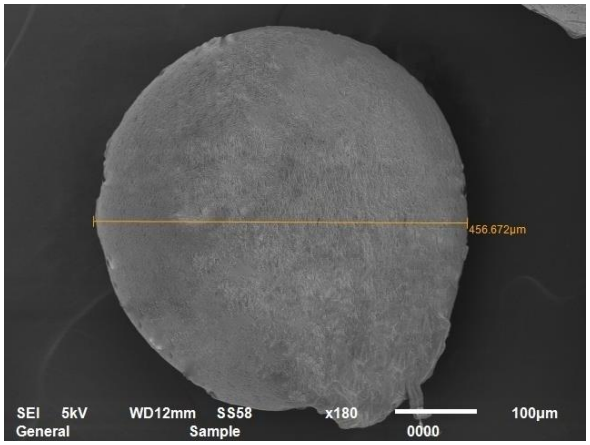
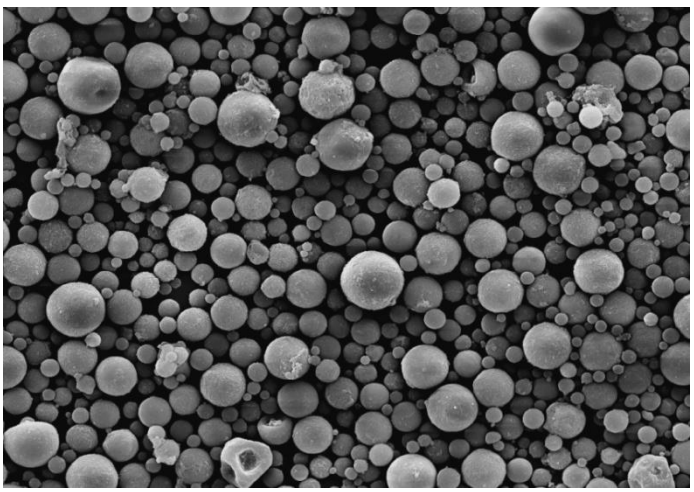
REFERENCES

[1]. Lachman L, Liberman H and Kanig J: The Theory and Practice of Industrial Pharmacy. 3rd ed. Varghese Publishing House 1987; 430.
[2]. Ghosh T and Jasti B: Oral controlled release solid dosage forms. Theory and Practice of Contemporary pharmaceuti Remington.Thescienceand practiceof pharmacy21st edition, vol. 1,939.
[3]. ErogluH ,Suheyla KASH, OnerL ,Sargon M,HincalAA. Preparation of bovine serum albumi microspheres containing Dexamethasone SodiumPhosphate andthe *invitro* evaluation.Turk JMedSci 2000;30:125–8.
[4]. HongW, KinamP.Oral controlled formulation design and drugdelivery :Theory practice1st edition,
[5]. http://www.doyouknow.in/Articles/Pharmaceutical/Controlled-Release-Drug- Delivery-System-Cdds.aspx, Nov 2010.
[6]. Venkatesan.P ,Manavalan.R, Valliappan.K. Microencapsulation :avital technique in novel drug delivery system.J Pharm Sci&Res2009; 1(4):26-35.
[7]. GunjaC, Prakash. B,Saha. RN.Microspheres technology and its applications. (PDF) . http://docstoc.com/docs/38166355/ review-on-microspheres, Nov 2010.
[8]. JainNK. Biodegradabl epolymers Controlled and Novel Drug Delivery1st edition, 81-239
[9]. Murali MohanBabuGV, HimasankarK, ChuruvuPS Narayan, Ramana MurthyKV. Controlled release of diclofenac sodium by gumkaraya-chitosan complex coacervate :*In vivo* evaluation.Ind JPharm Sci 2001; 63(5):408-12.
[10]. SinhaVR ,SinglaAK, WadhawanS, KaushikR, KumriaR, BansalK, DhawanS. Chitosanmicrospheres as a potential carrier for drugs. IntJPharm Sci2004;274:1-33
[11]. Murata, Y., Toniwa, S., Miyamoto, E., Kawashima, S., 1999. Preparation of alginate gel beads containing chitosanni cotinic acid saltand the functions .Eur. J. Pharm. Biopharm.48, 49–52.
[12]. Shailendra Shukla, Deepak Jain, Kavita Verma, Sofiya Verma. Formulation and *in vitro* characterization of alginate microspheres loaded with diloxanide furoate for *colon*-specific drugdelivery. 2010;4(4):199-204
[13]. YuelingZhang, WeiWei, Piping Lv, Lianyan Wang, Guanghui Maa .Preparation And evaluation of alginate–chitosan microspheres for oral delivery of insulin.. Eur.J.Pharm.2011;77,11-19.
[14]. TorradoJJ, IllumL ,DavisSS. Particle size and size distribution of albumin microspheres produced by heat and chemical stabilization. IJPharm1989;51(1):85-93
[15]. SahooSK, MohapatraS, DhalSK, BeheraBC, BarikBB. Formulation of floating microspheres of Ciprofloxacin Hydrochloride by crosslinking agent.Indpharm 2007: 6(58): 65-8
[16]. RajamanickamD, RajappanM, Varadharajan M,SrinivasanB. Formulationand evaluation of albumin microspheres containing aceclofenac; IJPSRR2010;4(1):112-7.
[17]. DeoreBV, MahajanHS, DeoreUV. Development andcharacterization of sustained release microspheres by quassi emulsion solvent diffusion method. IntJ Chem Tech Res2009; 1(3):634-42
[18]. MathewTS, GayathriDS, SandhyaKV. Formulation and Evaluation of Ketorolac Tromethamine-loaded Albumin microspheres for potential intramuscular administration. AAPS PharmSciTech 2007; 8(1):1-9.
[19]. JayaprakashS ,HalithSM, FirthouseMPU, KulaturanpillaiK, Abhijith, Nagarajan M. Preparation and evaluation of biodegradable microspheres of Methotraxate. Asian JPharm2009: 26-9.
[20]. ZhaoYL, TianF, LiuCJ, LiF, XingN. Preparation and evaluation of Poly(3- hydroxybutyrate) microspheres containing Bovine Serum Albumin for controlled release. Japp PolymSci 2008:3826-35.
[21]. BruneteSJA, DeaM,RamaS, BolasF, AlundaJM, RaposoR, MendezMT, Santiago TS, TorradoJJ. Treatment of experimental viscerall eishmaniasis with AmphotericinB instable albumin microspheres. Antimicrobial agents and chemotherapy 2004; 48:3246–52.
[22]. JongHP, ShinE, SikIlA, HyunHH, ChoMK, SoonHY, DongwonL, JohnMR, KyeHL, GilsonK. Dextran/PLGA Double-Layered Microspheres for Sustained Release of Doxorubicin Tissue Engineering and Regenerative Medicine2009;6(4):588-94.
[23]. LisaBrannon-Peppas. Polymers in Controlled Drug Delivery Biomaterials 1997.
[24]. AmitavaG ,UdayaKN, PrasantR, TanusreeN, ParthaR. Preparation, Evaluation and*invitro-invivo* Correlation(IVIVC) study of Lamivudine Loaded Microspheres. Research JPharm and Tech2008; 1(4):353-6.
[25]. AlagusundaramM, Madhu Sudana ChettyC, UmashankariK. Microspheresasa novel drug delivery system. IntJChem Tech Res2009; 1(1):166-70.
[26]. JaeHP, MingliY, KinamP .Biodegradable Polymers for Micro encapsulation of Drugs Molecules2005; 10:146-61.
[27]. PrasantKR, BhabaniSN. Formulation Design, Preparation Microspheres by Solvent Evaporation Method and It's *InVitro* Characterization. Arch Pharm Sci&Res 2009;1(1):166-70.
[28]. Mohsen J, Zahra B. Protein nanoparticle: A unique system as drug delivery vehicle. African JBiotechnology2008;7(25):715-29.
[29]. Truter EJ.Heat-stabilized albumin microspheres as a sustained drug delivery for the antimetabolite, 5-fluorouracil. Artif Cells Blood Substit Immobil Biotechnol 1995; 2
[30]. ShaileshTP .Preparation and evaluation of ethylcellulose coated egg albumin microspheres of Diltiazem Hydrochloride. JYoungPharm.2010;2(1):27-34.
[31]. ChinnaGB. Formulation and evaluation of Indomethacin microspheres using natural and synthetic polymers as controlled release dosage forms. IntJ Drug Discovery 2010;2(1):08-16.
[32]. FursuleRA, PatraCN, patilGB, KosalgeSB, patilPO, DeshmukhPK .Study of multiparticulate floating drug delivery system prepared by emulsion gelation technique. Int JChem Tech Res2009; 1(2):162-167.
[33]. AbhishekKumarJ, Jain CP,TanwarYS, NarukaPS. Formulation characterization and *in- vitro* evaluation of floating microspheres of Famotidine as a gastro retentive dosage form. Asian JPharm 2009;3(3):222-226.
[34]. TabassiSAS, RazaviN. Preparation and characterization of albumin microspheres encapsulated with PropranololHcl. DARU 2003;11(4):137-41.
[35]. MagharlaD D,NandhakumarS, VankayaluDS, SureshC. Preparation of poly (epsilon-caprolactone) microspheres containing etoposide by solvent evaporation method. Asian Jof Pharm Sci 2010; 5(3):114-22
[36]. MuthushamyK, ShibiKP. preparation andevaluation of albumin-chitosan microsphere containingtheophylline.Ind JPharmsci

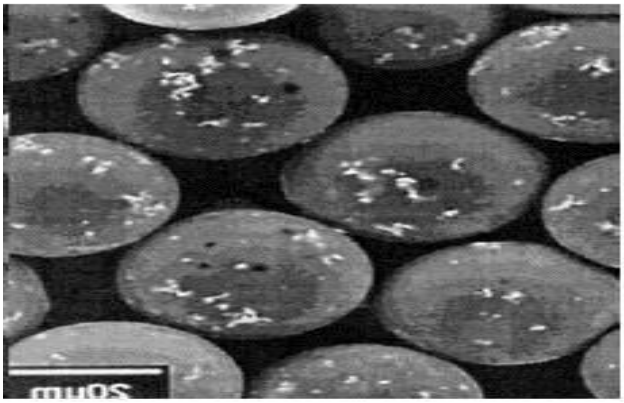
2010;50(171):117-241.
[37]. ArunachalamA. preparation andevaluation of ofloxacinmicrospheres using naturalgelatin polymer.Int Jof App Bioland pharm Tech 2010;1(1):61-67.
[38]. SrivastavaAK, NarayanaraoD. Floating microspheres of Cimetidine: formulation, characterization and *in-vitro* evaluation. Acta Pharm 2005;55:277-85.
[39]. www. **drugbank**. ca/**drugs**/DB01140
[40]. ChintaguntaP, Kavitha.K. Formulation and evaluation of Trimetazidine Hydrochloride loadedgelatin microspheres. IntJPharmacy &Pharm Sci 2010;2(3):67-70.

SEM PHOTO GRAPH CEFADROXIL





SEM PHOTO GRAPH CEFADROXIL



Dissolution Conditions:-

Volume of Dissolution Media	Dilution factor	pH Condition	Time (h)	SimulatedGI region
900ml	10	1.2	2	Stomach
900ml	10	6.8	1	Duodenum
900ml	10	7.4	7	Lowersmall intestine

Formulation Design Of Microspheres

	Formula- tion	Cefadroxil (mg)	Sodium Alginate (w/v)	Calcium Chloride (w/v)	Metolosesr (w/v)	Hpmc k100m (w/v)
I	F1	500	0.5%	3%		
	F2	500	1%	5%		
	F3	500	1.5%	7%		
II	F4	500	0.25%	5%	0.25%	
	F5	500	0.5%	5%	0.5%	
	F6	500	0.75%		0.75%	
III	F7	500	0.25%	5%		0.25%
	F8	500	0.5%	5%		0.5%
	F9	500	0.75%			0.75%

Micromeritic Properties ofDrug-loaded Microspheres

Batch No.	Angle of Repose (°)	Bulk Density (g/ml)	Tapped Density (g/ml)	Mean Diameter (μm)
F1	31°.25	0.487	0.696	823.16
F2	30°.15	0.698	0.757	795.26
F3	29°.20'	0.788	0.866	779.50
F4	27°.20'	0.739	0.808	863.17
F5	26°.30'	0.767	0.813	892.58
F6	26°.40'	0.728	0.833	970.60
F7	25°.60'	0.747	0.841	985.19
F8	28°.15'	0.788	0.855	908.60
F9	27°.80'	0.748	0.864	923.18

Standard Calibration Curve ofCEFADROXIL

Sl. No.	Concentration (μg/ml)	Absorbance at 260nm		
		pH 1.2	pH 6.8	pH 7.4
1	2	0.025	0.031	0.052
2	4	0.047	0.061	0.113
3	6	0.074	0.090	0.163
4	8	0.097	0.117	0.220
5	10	0.121	0.147	0.284
6	12	0.143	0.177	0.335

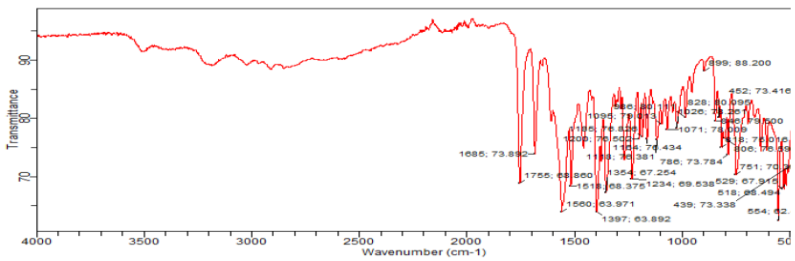
Drug Entrapment Efficiency of Microspheres

Sl. No.	Theoretical Drug Content (%)	ActualDrugContent (%)	Drug Entrapment Efficiency (%)
F1	81.53	57	71.405
F2	80.52	62	76.256
F3	77.76	66	84.336
F4	73.74	66	91.916
F5	71.87	67	93.713
F6	80.69	72	88.934
F7	76.89	71	94.276
F8	74.59	63	86.459
F9	78.76	69	88.091

Table: 5.6In-Vitro Release Data of Drug-loaded MicrospheresF1-F9

TIME(Hrs)	F1	F2	F3	F4	F5	F6	F7	F8	F9
0	0	0	0	0	0	0	0	0	0
1	24.53	27.59	19.6	28.39	29.48	23.66	10.56	8.56	9.87
2	49.13	45.31	31.56	46.89	35.48	35.82	19.67	11.35	10.48
3	64.48	57.68	39.84	57.85	53.59	48.79	32.41	20.69	15.78
4	75.68	66.7	50.84	66.68	64.06	58.84	38.15	28.56	22.38
5	88.89	77.3	63.74	73.59	75.59	69.58	55.68	46.89	34.56
6	99.13	89.06	74.85	86.58	89.23	74.48	74.48	57.89	49.86
7		99.69	88.62	97.89	89.23	88.09	85.25	68.59	53.94
8			99.78			98.59	98.79	74.89	65.68
9								83.58	77.56
10								99.82	85.17
11									91.85
12									98.89

FIGURE: 2 I.R. SPECTRA OF CEFADROXIL



1 I.R. SPECTRA OF HPMC K100M

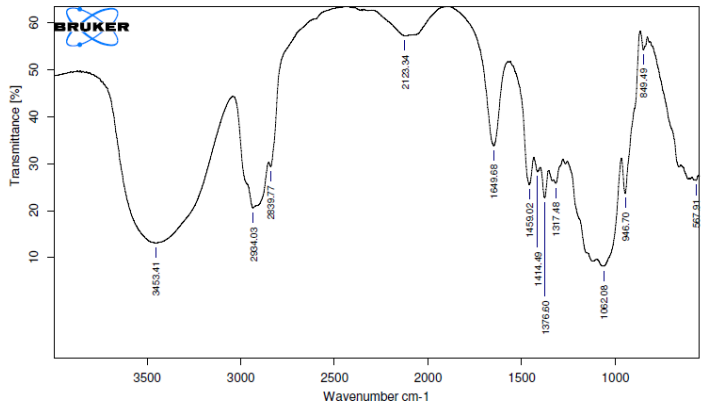
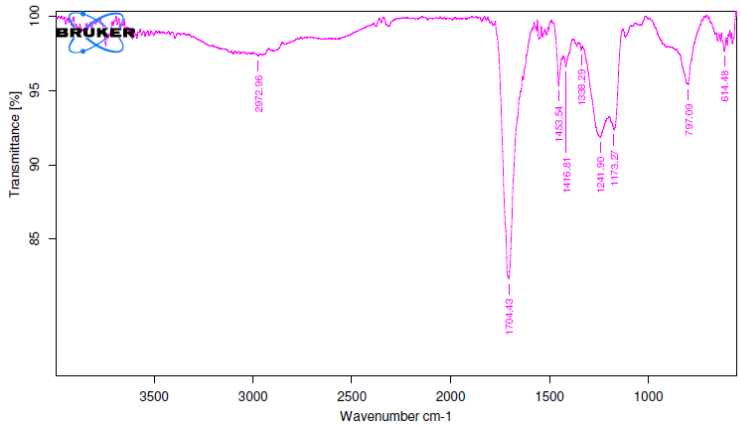
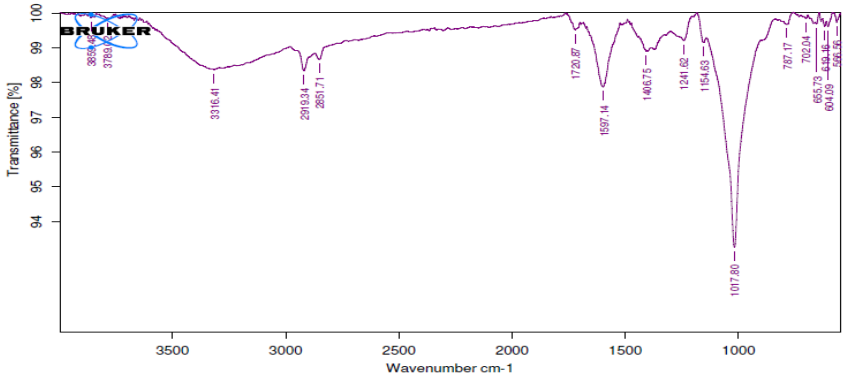


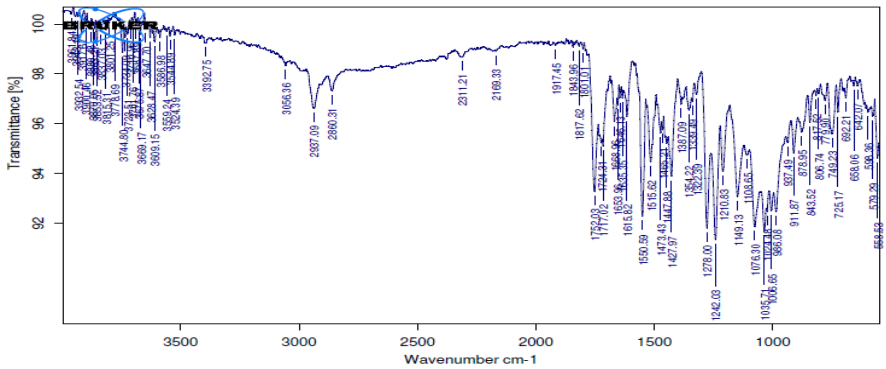
FIGURE:2.2 I.R. SPECTRA OF METOLOSE SR



IR SPECTRUM OF SODIUM ALGINATE:



IRSPECTRA OF CEFADROXIL OPTIMISED FORMULATION



UV SPECTRUM OF CEFADROXIL260nm

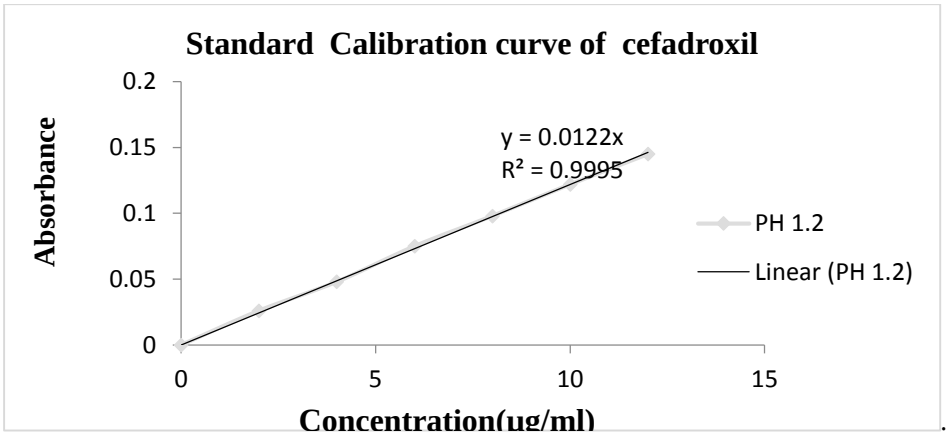


Figure2.6: Standard calibration curve of Absorbance,pH 1.2 of cefadroxil

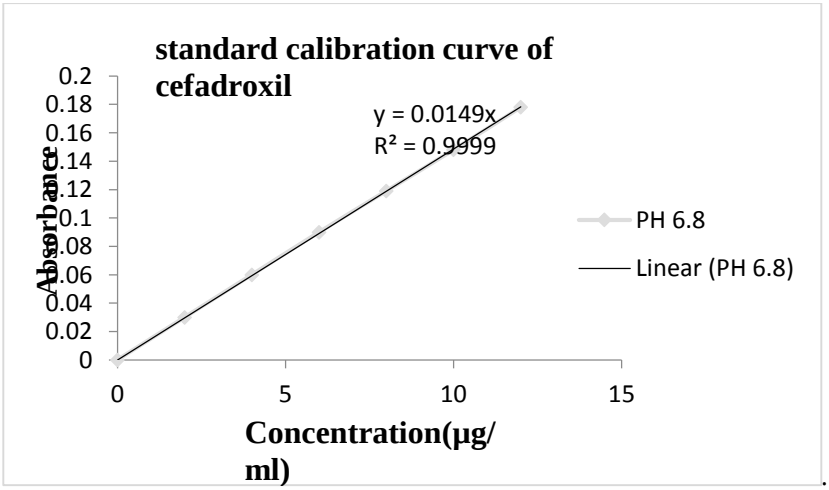


Figure2.7:standard calibration curve of Absorbance,pH 6.8 of CEFADROXIL

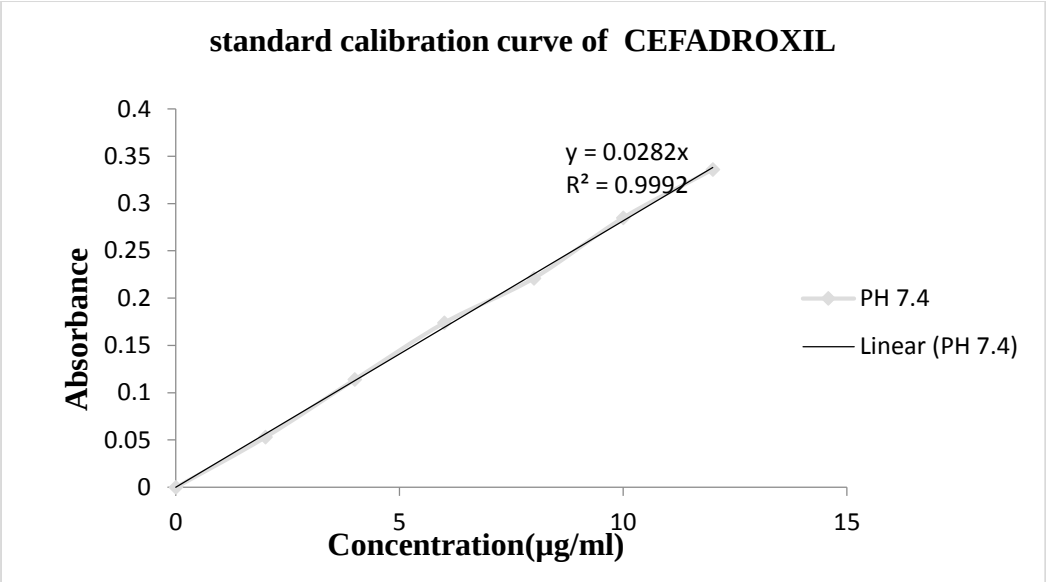
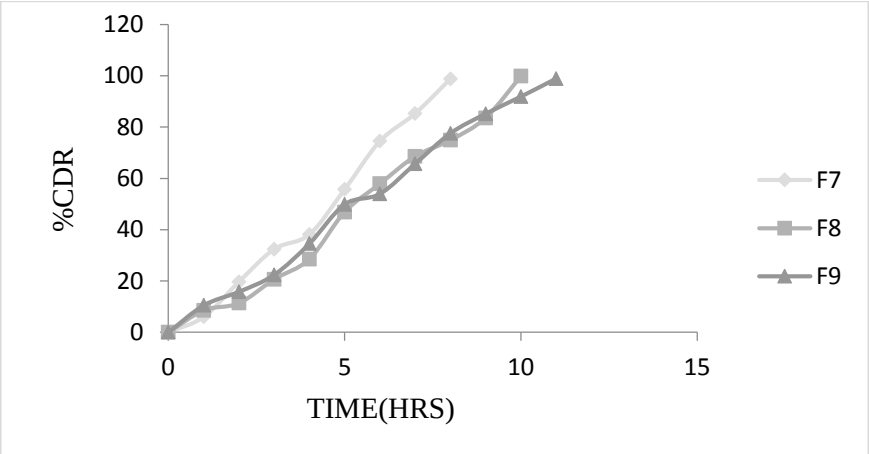


Figure: Standard calibration curve of Absorbance,pH 7.4 of CEFADROXIL



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