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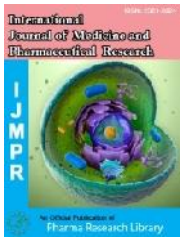

Research Article **Open Access**

Formulation and Evaluation of Ciprofloxacin Hydrochloride Floating Tablets

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A B S T R A C T

Floating drug delivery systems have shown to be of better significance in release rate for drugs having site specific absorption. The present study was an attempt to develop floating tablets of Ciprofloxacin Hcl which on oral administration prolongs its gastric residence time there by increasing bioavailability, diminishing side effects and enhanced patient compliance. Ciprofloxacin HCl is used to treat a number of infections including: infections of bones and joints, endocarditis, gastroenteritis, urinary tract infections, prostatitis, anthrax and chancroid. Ciprofloxacin an antibacterial having narrow absorption window in the upper part of gastrointestinal tract, was formulated as floating tablets using gas generating agent sodium bicarbonate and hydrophilic polymer HPMC K4M, eudrgit 100S, guar gum in different ratio by wet granulation techniques. The biological half life of Ciprofloxacin HCl is 3 to 5 hrs. The drug should be administered twice a day. The prepared formulations were evaluated with pre-compression parameters like bulk density, compressibility index, hausner ratio, angle of repose and postcompression parameters like appearance, weight variation, thickness, hardness, friability, drug content, tablet density, floating test, in-vitro dissolution study, kinetics of drug release. Comparion done by marketed samples shows exact results. The *in vitro* dissolution study of formulation F4 was 98.28% within 12 hours for good release and was fitted to kinetics of drug release for first, zero orders, korsmeyer peppas models.

Keywords: Ciprofloxacin HCl, Buoyancy, *In-vitro* dissolution, Release order Kinetics, Floating tablets.

A R T I C L E I N F O

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1. Introduction

Oral delivery of drugs is by far the most preferred route of drug delivery due to ease of administration, patient compliance and flexibility in formulation. The design of oral controlled drug delivery systems is primarily aimed to achieve more predictable and increased bioavailability. Gastric emptying time in humans, which is normally 2-3

hours through the main absorption area (stomach or upper part of intestine), can result in incomplete drug release from DDS leading to diminished efficacy of administered dose [1]. The aim of the present study is to formulation and evaluation of floating tablets of Ciprofloxacin HCl using HPMC K4M, Eudragit 100S, guar gum in different ratio with sodium bicarbonate, citric acid, magnesium stearate and talc by wet granulation techniques.

Floating Drug Delivery Systems have a bulk density is lower than gastric fluids and thus remain buoyant in stomach for a prolonged period of time, without affecting the gastric emptying rate [16]. While the system is floating on gastric contents, drug is released slowly at a desired rate from the system. After the release of drug, the residual system is emptied from the stomach. This result is increase in GRT and a better control of fluctuations in plasma drug concentrations. Floating systems can be classified into two types, non-effervescent system and effervescent systems [2]. Longer residence time in stomach could be advantageous for local action in the upper part of small intestine, for example treatment of peptic ulcer disease. Ciprofloxacin HCl is a broad-spectrum antibiotic active against both Gram-positive and Gramnegative bacteria.

2. Materials and Methods

Ciprofloxacin Hcl was obtained from Sreepathi Pharmaceuticals Ltd., India. HPMC K4M, Eudragit 100S and guar gum was obtained from Taian Ruitai Cellulose Co. Ltd., China. Sodium bicarbonate, citric acid, starch mucilage was obtained from RFCL Ltd., India. Talc was obtained from Golcha Group, India. Magnesium stearate was obtained from Loba Chemie Pvt. Ltd., India.

Preparation of Ciprofloxacin Hcl Floating Tablets: Floating tablets of Ciprofloxacin Hcl were prepared by wet granulation technique using various polymers like HPMC K4M, Eudragit100S, Guar gum with combination of sodium bicarbonate and citric acid as gas generating agent. Formulation table as shown in table no 01. The composition of each formulation is given in formulation table. Ciprofloxacin Hcl is passed through sieve no.20, HPMC K4M, Eudragit 100S,Guar gum, sodium bicarbonate, citric acid passed through sieve no.40. Magnesium stearate is passed through sieve no 60. The shifted materials of Ciprofloxacin Hcl was geometrically mixed with polymer and sodium bicarbonate and citric acid and blended for 10minutes.Then add starch mucilage slowly drop wise manner to form a coherent mass. The formed coherent mass was sieved manually through sieve no.16 to form granules [3]. Then the granules are collected and dried in hot air oven at 40+ 2^0C for 2 hours. The dried granules were passed through sieve no.20. Magnesium stearate is added to the dried granules then subjected to pre formulation studies. After the completion of preformulation studies, the granules of all formulations were compressed into tablets by using tablets punching machine.

Preformulation Studies

Bulk Density:

It is the ratio of total mass of powder to the bulk volume of powder. It was measured by pouring the weighed powder in to a measuring cylinder and the initial volume was noted. This initial volume is called bulk volume[4]. The powder was tapped 3 times till a constant volume called bulk density was obtained. From this, the bulk density is calculated according to the formula mentioned below. It is expressed in g/ml and is given by

$$P_t = m/v_t$$

Where,

m = mass of the granules

v_b = bulk volume

Tapped Density:

After determining the poured bulk density, Weighed quantity of API was taken into a graduated cylinder [5]. Volume occupied by DRUG was noted down. Then the cylinder was subjected to 500, 750 & 1250 taps in tap density tester (Electro Lab USP II). According to USP, the blend was subjected for 500 taps. % Volume variation was calculated and subjected for additional 750 taps. % Variation is calculated.

$$Pt = m/vt$$

Tapped bulk density = Mass of powder/Tapped volume of the powder.

Compressibility Index: Weighed API was transferred to 100ml-graduated cylinder and subjected to 500,750&1250 taps in tap density tester (Electro lab) [6]. The difference between two taps should be less than 2%. The %of compressibility index calculated using formula

Hausner's Ratio:

It is measurement of frictional resistance of the drug. The ideal range should be 1.2 –1.5. It is the determined by the ratio of tapped density and bulk density.

$$\text{Hausner's ratio} = v_i / v_b$$

Where

v_t = Tapped volume

v_i = Bulk volume

Angle of repose:

Angle that can be obtained between the free surface of a powder heap and horizontal plane [7]. The angle of repose was measured by allowing the powders to fall over a graph sheet placed on horizontal surface through a funnel kept at a certain convenient height (about 2 cm). The height of the heap was measured and then circumference of the base of heap was drawn on a graph sheet with the help of a pencil. The radius of the circle obtained was measured. The angle of repose is given as,

$$\theta = \tan^{-1}(h/r)$$

Where

Θ = angle of repose

H = height of the heap

R = radius of the base of the heap

Characterization of ciprofloxacin HCl floating tablets:

The formulated tablets were evaluated for the following physicochemical characteristics:

General appearance: The formulated tablets were assessed for its general appearance and observations were made for shape, color, texture and odour[8].

Hardness test:

Hardness of the tablet was determined by using the Monsanto hardness tester. The lower plunger was placed in contact with the tablet and a zero reading was taken. The

plunger was then forced against a spring by turning a threaded bolt until the tablet fractured [9]. As the spring was compressed a pointer rides along a gauge in the barrel to indicate the force.

Weight Variation:

20 tablets were selected and weighed collectively and individually. From the collective weight, average weight was calculated. Each tablet weight was then compared with average weight to ascertain whether it was within permissible limits or not [10]. Not more than two of the individual weights deviated from the average weight by more than 5% for 500 mg tablets and none by more than double that percentage. The percentage deviation was calculated by using following formula

% Deviation = (Individual weight – Average weight) / Average weight x 100

Friability test: 20 previously weighed tablets were placed in the apparatus [11]. Which was given 100 revolutions and the tablets were reweighed. The percentage friability was calculated by using the following formula,

Percentage friability = initial weight-final weight /initial weight × 100.

Estimation of Drug content:

20 tablets of each formulation were weighed and powdered. The quantity of powder equivalent to 100 mg of Ciprofloxacin Hydrochloride was transferred in to a 100 ml volumetric flask and volume made up with 0.1N HCl. Further 1ml of the above solution was diluted to 10 ml with 0.1N HCl and absorbance of the resulting solution was observed at 277 nm [12].

Floating test:

The tablets were placed in a 100ml beaker containing 0.1N Hcl. The time between introducing of dosage form and its buoyancy on 0.1N Hcl and the time during at which the dosage form remain buoyant were measured [13].

Buoyancy lag time*:*

The time taken for the dosage form to emerge on surface of medium is Called Floating lag time [17]. Total duration of time during which the dosage form remains buoyant is called Total floating time (TFT).

***In Vitro* Dissolution studies of tablets:** 900ml 0f 0.1 HCl was placed in vessel and the USP apparatus –11 (Paddle Method) was assembled [14]. The medium was allowed to equilibrate to temp of 37 $\pm$ 0.5°c. Tablet was placed in the vessel and the vessel was covered the apparatus was operated for 12 hours and then the medium 0.1 N HCl was taken and process was continued from 0 to 12 hrs at 50 rpm. At definite time intervals of 5 ml of the receptors fluid was withdrawn, filtered and again 5ml receptor fluid was replaced. Suitable dilutions were done with receptor fluid and analyzed by spectrophotometrically at 277nm using UV-spectrophotometer.

Kinetic analysis of dissolution data:

The analysis of drug release mechanism from a pharmaceutical dosage form is an important but complicated process and is practically evident in the case of matrix systems [15]. As a model-dependent approach, the dissolution data was fitted to five popular release models such as zero-order, first-order, diffusion and exponential equations, which have been described in the literature. The order of drug release from matrix systems was described by using zero order kinetics or first orders kinetics. The mechanism of drug release from matrix systems was studied by using Higuchi equation, erosion equation and Peppa's-Korsemeyer equation.

Zero Order Release Kinetics:

It defines a linear relationship between the fraction of drug released versus time [18].

$$\mathbf{Q = k_o t}$$

Where, Q is the fraction of drug released at time t and k_o is the zero order release rate constant.

First Order Release Kinetics:

Wagner assuming that the exposed surface area of a tablet decreased exponentially with time during dissolution process suggested that drug release from most of the slow release tablets could be described adequately by apparent first-order kinetics [19]. The equation that describes first order kinetics is

$$\mathbf{In\ (1\text{-}Q) = -\ K_1 t}$$

Where,Q is the fraction of drug released at time t and k_1 is the first order release rate constant.

Higuchi equation: It defines a linear dependence of the active fraction released per unit of surface (Q) on the square root of time [20].

$$\mathbf{Q = K_2 t^{½}}$$

Where, K2 is the release rate constant.

Power Law:

In order to define a model, which would represent a better fit for the formulation, dissolution data was further analyzed by Peppa's and Korsemeyer equation (Power Law).

$$\mathbf{M_t/M_\sim = K.t^n}$$

Where,

M_t is the amount of drug released at time t and M_α is the amount released at time α, thus the M_t/M_α is the fraction of drug released at time t,k is the kinetic constant and n is the diffusional exponent [21].

3. Results and Discussion

Drug-Polymer compatibility studies: The physical and chemical state of polymers like HPMC K4M, Eudragit 100S, Guar gum and their admixture of polymer and drug used in Ciprofloxacin floating tablets prepared were studied by FTIR Figures as shown in 02-05 and interpretation table as shown in 06.

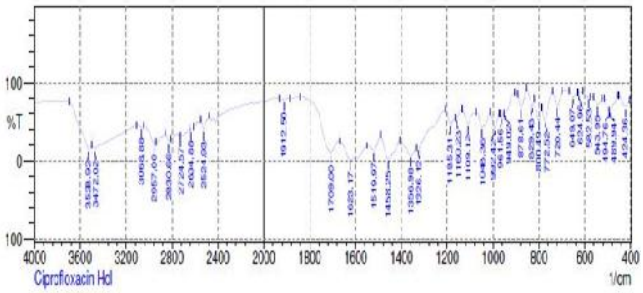

Figure 1: FTIR Spectrum of Ciprofloxacin Hcl

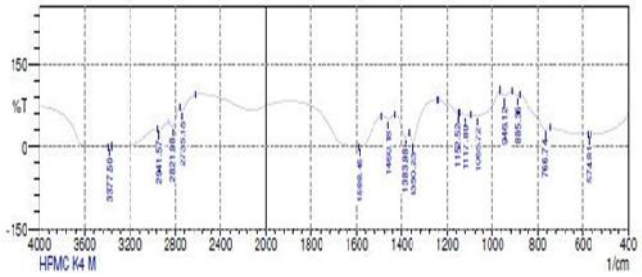

Figure 02: FTIR Spectrum of HPMC K4M

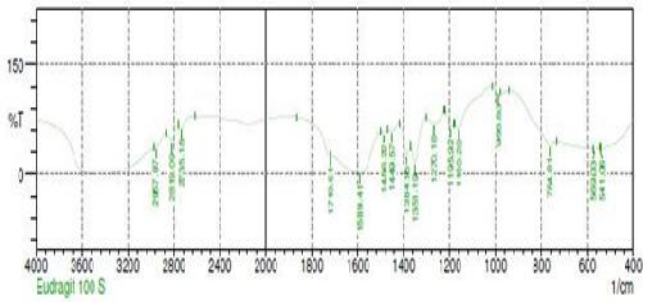

Figure 03: FTIR Spectrum of Eudragit 100S

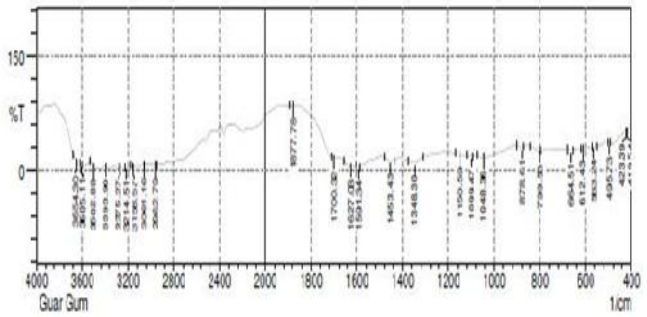

Figure 04: FTIR Spectrum of Guar gum

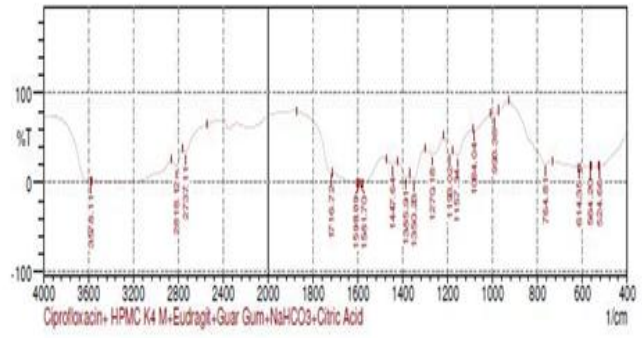

Figure 05: FTIR Spectrum of Ciprofloxacin Hcl, HPMC K4M, Eudragit 100S, Guar gum, NAHCO3 & Citric acid

Preformulation studies of granules of Ciprofloxacin Hcl floating tablets*:*

The granules of Ciprofloxain Hcl floating tablets were prepared by wet granulation technique. The prepared granules are subjected to preformulation studies by following methods.

Angle of repose:

The granules of all seven formulations are subjected to angle of repose by funnel method as shown in table 07. The value of angle of repose was found in the range of 22º71′-26º15′. The result proved that the granules of all formulations showed excellent flow properties.

Bulk density:

Bulk density of all the granules was measured by using measuring cylinder method and the resultant values was found in the range of 0.37-0.85 g/cm as shown in table 07. It showed that the bulkiness is within the acceptable limits.

Tapped density: The tapped density of all granules was determined by tapping the measuring cylinder for required times and the values are were noted in table and the tapped density values was found in the range of 0.42-0.49 g/cm as shown in table 07. The result proven that the tapped density values are within the acceptable limits.

Compressibility index:

The compressibility of granules are done by tapped density minus bulk density and divided with tapped density values as shown in table 07. And the resultant values is in the range of 9-15. It indicates that the granules showed good flow properties.

Hausner's ratio:

It is the ratio of tapped density value to bulk density value and the resultant values of Hausner's ratio of all the formulations is between 1.10-1.18 which indicate that the granules shows good flow, as shown in table 07.

Characterization of Ciprofloxacin Hcl floating tablets

General appearance:

The formulated tablets were evaluated for organoleptic characters. The tablets are circular in shape, yellowish in colour, with no characteristic odour, as shown in table 08. All tablets showed elegance in appearance.

Hardness test:

The hardness of Ciprofloxacin Hcl floating tablets were measured by Pfizer hardness tester and the values were tabulated in table 08. The hardness of all tablets in all formulations was within the range of 4.5-5.1 kg/cm². So all formulated tablets passes the test.

Friability test:

The friability of Ciprofloxacin Hcl floating tablets were performed by using Roche friabilator and the the friability of all formulated tablets was within 1%. It proed that all formulations are within the acceptable limits, as shown in table 08.

Diameter: The diameter of Ciprofloxacin Hcl floating tablets were measured by using Besto Vernier calipers and there is no deviation in the diameter values of all formulated tablets indicates uniform diameter, as shown in table 08.

Thickness:

The thickness of Ciprofloxacin Hcl floating tablets were measured by using Vernier calipers. Thickness must be controlled to facilitate packaging, as shown in table 08. The result showed that the tablets of all the formulations shows uniform thickness.

Weight variation test: The weight variation of tablets were done by weighing the individuat tablet weight and the average weight of 20 tablets which were selected randomly from each formulation batches. No more than two tablets should go more than the preferred deviation. as shown in table 09.

Drug content (%): The percentage of drug content were done by dissolving individual tablet in 0.1N Hcl and tranferred to a 100ml volumetric flask. The absorbance of the resulting solution is measured by Ultraviolet Spectroscopy at 278nm. As per IP, the content uniformity should be in the range of 90-110%. The result showed that the percentage of Ciprofloxacin Hcl in all formulations was ranging from 96-99%. It released that the drug is uniformly dispersed in the formulation and confirms the homogeneous mixing of the drug and the polymer, as shown in table 09.

Buoyancy lag time: It is the time taken during which of dosage form remains buoyant on 0.1N Hcl were measured and the values were listed in table 10. The buoyancy lag time values were found in the range of 134-166 sec.

Total floating time: It is the total duration of time during which the dosage form remains buoyant is measured and the values were ranges between 356-485 min which was noted in table 10.

In-vitro* dissolution studies*:

The percentage drug release of all formulations after 12 hours using HPMC K4M, Eudragit 100S and guar gum was found to be 88.12% (F1), 90.68% (F2) and 73.45% (F3) repectively. And the percentage drug release of combination of HPMC K4M with Eudragit 100S is 98.87% (F4), Eudragit 100S with guar gum is 85.67% (F5), HPMC K4M with guar gum is 79.93% (F6) and HPMC K4M with Eudragit 100S and guar gum is 95.45% (F7). From the in-vitro drug release, it was observes that the maximum drug release was found in formulation F4 is 98.87%. It shows that F formulation exhibits optimized drug release when compared with other formulation. The dissolution profile of all formulations of Ciprofloxacin Hcl floating tablets were shown in following table 11& figure 12.

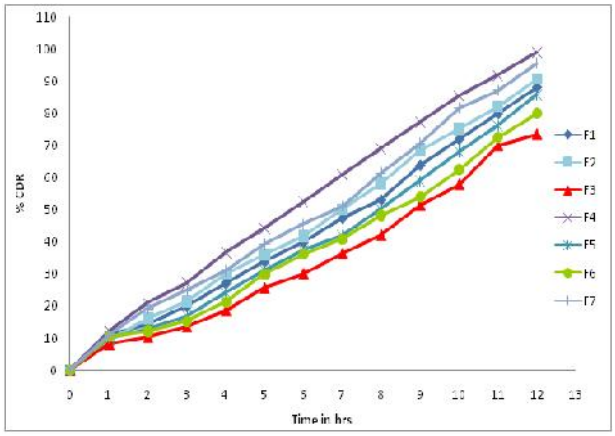

Figure 6: Comparitive In-vitro Dissolution study of Ciprofloxacin Hcl floating tablets (F1-F7)

Kinetic Analysis of dissolution data: To know the mechanism of drug release from these formulations, the data were treated according to zero order, first order, Higuchi's model and Korsmeyer model, as shown in table 13. The release rate kinetic data for all the formulations are shown in table. When data were plotted according to zero order, the formulation showed high linearity with regression co-efficient values (R^2) between 0.993 – 0.998.

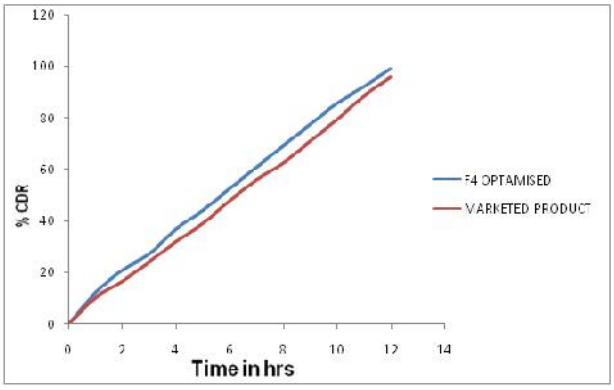

Figure 7: Percentage Release of Marketed Sample (Cipro XR 250mg) & Ciprofloxacin Hcl floating tablets

Discussion

Hydrodynamically balanced tablets of Ciprofloxacin Hcl can be formulated with an approach to increase gastric residence and thereby improves drug bioavailability. An attempt to developed floating tablets of Ciprofloxacin Hcl using HPMC K4M, Eudragit100S and guar gum as different polymers and sodium bicarbonate combination with citric acid as gas generating agent which is prepared by wet granulation technique (F1- F7) was achieved. Preformulation studies such as angle of repose, bulk density, tapped density, compressibility index, Hausner's ratio were performed and the result showed that all the parameters are within the limits. Tablets were prepared by wet granulation method and evaluated for general appearance, hardness test, friability test, uniformity in weight, drug content estimation. All the formulations were found to be good appearance without showing any chipping, capping and sticking defects and other parameters were also passed the test. FTIR Spectroscopic studies indicated that the drug is compatible with all excipients and there is no drug- polymer interactions. When comparing all formulation F4 showed optimized drug release of 98.87% at the end of 12 hours. These optimized F4 formulation showed buoyancy lag time of 134 sec. and floating time of 12.5 hrs respectively. Data obtained from kinetic treatment revealed F4 formulations follow Koresmayer-peppas model. The 'n' value is 0.861 indicates the non Fickian diffusion. From the comparative study of optimized formulation of Ciprofloxacin Hcl (F4) with marketed product (Cipro XR 500mg) shows that F4 is have greater release than marketed product.

Conclusion

Hydrodynamically balanced tablets of Ciprofloxacin Hcl can be formulated with an approach to increase gastric residence and thereby improve drug bioavailability. An attempt to develop floating tablets of Ciprofloxacin Hcl, using sodium bicarbonate as gas generating agents and HPMC K4M as hydrophilic polymer by wet granulation technique was achieved. From the above study, it was concluded that Ciprofloxacin Hcl can formulated as Floating drug delivery system which helps to increase gastric residence time there by it increases the bioavailability and half life of Ciprofloxacin Hcl.

Table 1: Formulation of ciprofloxacin Hcl floating tablets

Formulation Batches	Ciprofloxacin Hcl	HPMC K4M	Eudragit 100S	Guar gum	Sodium bicarbonate	Citric acid	Starch mucilage	Magnesium stearate
F1	250	150	-	-	50	15	25	10
F2	250	-	150	-	50	15	25	10
F3	250	-	-	150	50	15	25	10
F4	250	75	75	-	50	15	25	10
F5	250	-	75	75	50	15	25	10
F6	250	75	-	75	50	15	25	10
F7	250	50	50	50	50	15	25	10

Table 2: Interpretation of FTIR data of Ciprofloxacin Hydrochloridem HPMC K4 M, Eudragit 100 S, Guar gum & Mixture of compounds.

FTIR Spectrum of drugs	Wave number	Assignment (Functional groups)
Ciprofloxacin Hydrochloride	1623.17	C=O carbonyl group
	1458.25	C-N Stretch
	3528.92	O-H Stretch
	2830.66	N-C Stretch
	1519.97	C=O Stretch of quinoline
HPMC K4M	1588.45	C=C Stretching
	1460.18	Ar C-C Stretching
	1383.98	C-O Stretching
	3377.50	O-H Stretching
	2941.57	CH2 Stretching
Eudragit 100S	2957.97	C-H Stretching
	1719.61	C=O Stretching
	1449.57	C=C Stretching
Guar gum	3393.90	O-H Stretching vibration
	2962.79	C-H Stretching of CH2 group
	1348.30	Symmetrical deformation of CH2 group
	1150.59	C-OH & primary alcohol; -CH2OH Stretching mode
Ciprofloxacin Hcl, HPMC K4M, Eudragit 100S, Guar gum, NAHCO3 & Citric acid	1598.09	C=O Stretching
	1447.64	C-N Stretch
	3578.11	O-H Stretch
	2818.12	Aliphatic C-H Stretch
	1581.70	C=C Stretching
	1385.91	C-O Stretching

Table 3: Evaluation of granules of Ciprofloxacin HCl floating tablets

S.No	Formulation code	Angle of repose	Bulk density (g/cm)	Tapped density (g/cm)	Compressibility index (%)	Hausner's ratio
1	F1	22º71′	0.42±0.07	0.49±0.01	11.22 ± 0.84	1.16 ± 0.01
2	F2	22º91´	0.38±0.02	0.43±0.03	11.34 ± 0.91	1.12 ± 0.06
3	F3	24º52´	0.39±0.04	0.43±0.04	9.86 ± 0.52	1.10 ± 0.07
4	F4	24º01′	0.37±0.06	0.42±0.05	12.59 ± 0.45	1.14 ± 0.09
5	F5	25º17´	0.37±0.05	0.41±0.06	11.16 ± 0.68	1.13 ± 0.08
6	F6	26º15´	0.40±0.08	0.44±0.07	10.71 ± 0.74	1.10 ± 0.06
7	F7	24º92´	0.85±0.07	0.45±0.08	15.39 ± 0.92	1.18 ± 0.04
All the values mentioned as mean ±SD; Number of trials (n)=3						

Table 4: Evaluation of Ciprofloxacin Hcl floating tablets

S.No	Formulation code	Floating Lag Time (Sec)	Floating Time (hours)
1	F1	150 ± 3	10.0 ± 0.02
2	F2	144 ± 4	10.5 ± 0.04
3	F3	151 ± 2	8.00 ± 0.03
4	F4	134 ± 5	12.5 ± 0.06
5	F5	154 ± 3	9.00 ± 0.02
6	F6	166 ± 2	9.50 ± 0.04
7	F7	140 ± 5	11.00± 0.06

Table 5: Weight variation and Estimation of Drug content of floating tablets

S. no	Formulation code	Weight variation	Drug content (%)
1	F1	498 ± 2.5	98.12
2	F2	496 ± 3.2	97.23
3	F3	497 ± 2.7	98.63
4	F4	499 ± 1.13	99.54
5	F5	498 ± 3.5	97.83
6	F6	495 ± 4.3	97.38
7	F7	497 ± 4.2	99.17

Table 10: Floating Lag time and floating time of formulations

S. No.	Formulation code	Hardness (kg/cm)	Friability (%)	Thickness (mm)	Diameter (mm)
1	F1	4.85 ± 0.03	0.631±0.09	4.17 ± 0.02	10.19
2	F2	4.80 ± 0.06	0.413±0.11	5.14 ± 0.04	10.8
3	F3	5.10 ± 0.05	0.462±0.14	5.16 ± 0.03	11.0
4	F4	4.75 ± 0.04	0.381±0.12	4.40 ± 0.05	10.7
5	F5	4.50 ± 0.07	0.54±0.08	4.16 ± 0.02	10.9
6	F6	5.00 ± 0.08	0.761±0.14	4.50 ± 0.01	11.0
7	F7	4.80 ± 0.09	0.62±0.14	4.20 ± 0.04	10.8

Table 11: Comparative In-vitro Dissolution study of Ciprofloxacin Hcl floating tablets (F1-F7)

Time(hrs)	Cumulative % Drug Release						
	F1	F2	F3	F4	F5	F6	F7
1	11.22	9.43	8.24	12.18	9.91	10.51	10.98
2	14.30	16.13	10.38	20.90	12.83	12.22	19.06
3	19.80	21.51	13.68	27.13	16.86	15.27	24.81
4	27.01	29.94	18.7	36.78	24.20	21.38	31.04
5	33.73	35.93	25.66	44.00	31.16	29.82	39.23
6	39.84	41.80	30.18	52.43	37.40	36.17	45.58
7	47.30	50.23	36.30	60.74	41.80	40.94	51.08
8	53.04	58.17	42.04	69.05	50.23	48.15	61.47
9	63.92	68.68	51.45	77.24	58.91	54.02	70.52
10	71.98	75.28	57.81	85.43	68.07	62.57	81.64
11	79.81	82.13	69.91	91.91	76.14	72.47	87.02
12	88.12	90.68	73.45	98.87	85.67	79.93	95.45

Table 12: Kinetic Analysis of dissolution data

S.No	Formulation code	Regression co-efficient ($R^{2)}$			Korsmeyer' plot	
		Zero order plot	First order plot	Higuchi's plot	R^2	Slope (n)
1	F1	0.993	0.886	0.896	0.970	0.887
2	F2	0.997	0.889	0.910	0.993	0.929
3	F3	0.988	0.880	0.878	0.997	0.868
4	F4	0.998	0.763	0.938	0.996	0.861

5	F5	0.988	0.880	0.878	0.998	0.806
6	F6	0.988	0.880	0.878	0.998	0.825
7	F7	0.995	0.832	0.912	0.990	0.877

Table 14: Percentage Release of Marketed Sample (Cipro XR 250mg) &Ciprofloxacin Hcl floating tablets

S.No	Time (hrs)	Cumulative percentage drug release	
		Marketed sample	Optimized formulation of Ciprofloxacin Hcl (F4)
1	1	10.23 ± 0.02	12.18 ± 0.04
2	2	16.57 ± 0.05	20.90 ± 0.06
3	3	24.06 ± 0.04	27.13 ± 0.03
4	4	31.85 ± 0.06	36.78 ± 0.02
5	5	38.92 ± 0.02	44.00 ± 0.01
6	6	47.73 ± 0.03	52.43 ± 0.06
7	7	55.81 ± 0.08	60.74 ± 0.08
8	8	62.34 ± 0.04	69.05 ± 0.09
9	9	70.71 ± 0.08	77.24 ± 0.08
10	10	79.11 ± 0.06	85.43 ± 0.07
11	11	88.19 ± 0.04	91.91 ± 0.06
12	12	95.61 ± 0.05	98.87 ± 0.05
All the values mentioned as mean ± S.D; (n)=3			

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