Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 12 [7] June 2023: 164-174
©2023 Academy for Environment and Life Sciences, India
Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

Formulation and Evaluation of Floating Fenoverine Tablets

Gulam Mehmood Afzal[1], Shahid Mohammed[2], Abdul Manan[3], Ramya Sri. S[4]
[1, 2, 3]Department of Pharmaceutics, Deccan School of Pharmacy, Darus Salam, Hyderabad, Telangana-500001, India
[4]Department of Pharmacy, University College of Technology, Osmania University, Hyderabad, Telangana-500007, India
Corresponding Author's Email Id- surapharmalabs1@gmail.com

ABSTRACT
Gastro-retentive dosage forms enable prolonged and continuous input of the drug to the upper parts of the gastrointestinal tract and improve the bioavailability of medications those are characterized by a narrow absorption window. The purpose of this research was to develop a novel gastro retentive drug delivery system based on direct compression method for sustained delivery of active agent to improve the bioavailability, reduce the number of doses and to increase patient compliance. Gastro retentive floating tablets of Fenoverine were prepared by direct compression method using altered concentrations of Carbopol, HPMC K 100 and Ethyl Cellulose as polymers. The prepared tablets of Fenoverine were evaluated tablet hardness, uniformity of weight, friability, uniformity of content, in vitro buoyancy test and in vitro dissolution study. All the compositions were resulted in adequate Pharmacopoeial limits. Compatibility studies was execution during FTIR shown that there was absence of probable chemical interaction between pure drug and excipients. The formulations were evaluated for various physical parameters, buoyancy studies, dissolution studies, dissolution parameters and drug released mechanisms. F5 formulation showed maximum floating time of 12 hours and gave slow and maximum drug release of Fenoverine spread over 12 hours. Finally the tablet formulations found to be economical and may overcome the draw backs associated with the drug during its absorption.
Key words: *Fenoverine, Carbopol, HPMC K 100, Ethyl Cellulose and Floating Tablets.*

Received 08.05.2023 Revised 12.05.2023 Accepted 23.06.2023

INTRODUCTION

Oral delivery of drugs is the most preferable route of drug delivery. Oral route is considered most natural, uncomplicated, convenient and safe due to its ease of administration, patient compliance and flexibility in formulation and cost effective manufacturing process [1]. Many of the drug delivery systems, available in the market are oral drug delivery type systems Pharmaceutical products designed for oral delivery are mainly immediate release type or conventional drug delivery systems, which are designed for immediate release of drug for rapid absorption. These immediate release dosage forms have some limitations such as:

1. Drugs with short half-life require frequent administration, which increases chances of missing dose of drug leading to poor patient compliance.
2. A typical peak-valley plasma concentration-time profile is obtained which makes attainment of steady state condition difficult.
3. The unavoidable fluctuations in the drug concentration may lead to under medication or overmedication as the C_{ss} values fall or rise beyond the therapeutic range.
4. The fluctuating drug levels may lead to precipitation of adverse effects especially of a drug with small therapeutic index, whenever overmedication occurs [2].

In order to overcome the drawbacks of conventional drug delivery systems, several technical advancements have led to the development of controlled drug delivery system that could revolutionize method of medication and provide a number of therapeutic benefits [3].

Controlled Drug Delivery Systems:

Controlled drug delivery systems have been developed which are capable of controlling the rate of drug delivery, sustaining the duration of therapeutic activity and/or targeting the delivery of drug to a tissue.[4]
Controlled drug delivery or modified drug delivery systems are divided into four categories.

1. Delayed release
2. Sustained release

3. Site-specific targeting
4. Receptor targeting

More precisely, controlled delivery can be defined as:-

1. Sustained drug action at a predetermined rate by maintaining a relatively constant, effective drug level in the body with concomitant minimization of undesirable side effects.
2. Localized drug action by spatial placement of a controlled release system adjacent to or in the diseased tissue.
3. Targeted drug action by using carriers or chemical derivatives to deliver drug to a particular target cell type.
4. Provide physiologically/therapeutically based drug release system. In other words, the amount and the rate of drug release are determined by the physiological/ therapeutic needs of the body.[5]

MATERIAL AND METHODS

Fenoverine Provided by SURA LABS, Dilsukhnagar, Hyderabad, Carbopol from Merck Specialities Pvt Ltd, HPMC K 100 from Merck Specialities Pvt Ltd, Ethyl Cellulose from Merck Specialities Pvt Ltd, Sodium bicarbonate from Merck Specialities Pvt Ltd, Citric acid from Merck Specialities Pvt Ltd, Aerosil from Merck Specialities Pvt Ltd, Mg Stearate from Merck Specialities Pvt Ltd, MCC from Merck Specialities Pvt Ltd.

METHODS

Drug – Excipient compatibility studies

Fourier Transform Infrared (FTIR) spectroscopy:

The compatibility between the pure drug and excipients was detected by FTIR spectra obtained on Bruker FTIR Germany (Alpha T).The solid powder sample directly place on yellow crystal which was made up of ZnSe. The spectra were recorded over the wave number of 4000 cm^{-1} to 550 cm^{-1}.

Analytical method development:

a) Determination of absorption maxima:

A solution containing the concentration 10 µg/ mL drug was prepared in 0.1N HCL UV spectrum was taken using Double beam UV/VIS spectrophotometer. The solution was scanned in the range of 200 – 400 nm.

b) Preparation calibration curve:

10mg Fenoverine pure drug was dissolved in 10ml of methanol (stock solution1) from stock solution 1ml of solution was taken and made up with10ml of 0.1N HCL (100µg/ml). From this 1ml was taken and made up with 10 ml of 0.1N HCL (10µg/ml). The above solution was subsequently diluted with 0.1N HCL to obtain series of dilutions Containing 5, 10, 15, 20, 25 µg /ml of per ml of solution. The absorbance of the above dilutions was measured at 258 nm by using UV-Spectrophotometer taking 0.1N HCL as blank. Then a graph was plotted by taking Concentration on X-Axis and Absorbance on Y-Axis which gives a straight line Linearity of standard curve was assessed from the square of correlation coefficient (R^2) which determined by least-square linear regression analysis.

Preformulation parameters

The quality of tablet, once formulated by rule, is generally dictated by the quality of physicochemical properties of blends. There are many formulations and process variables involved in mixing and all these can affect the characteristics of blends produced. The various characteristics of blends tested as per Pharmacopoeia.

Angle of repose:

The frictional force in a loose powder can be measured by the angle of repose. It is defined as, the maximum angle possible between the surface of the pile of the powder and the horizontal plane. If more powder is added to the pile, it slides down the sides of the pile until the mutual friction of the particles producing a surface angle, is in equilibrium with the gravitational force. The fixed funnel method was employed to measure the angle of repose. A funnel was secured with its tip at a given height (h), above a graph paper that is placed on a flat horizontal surface. The blend was carefully pored through the funnel until the apex of the conical pile just touches the tip of the funnel. The radius (r) of the base of the conical pile was measured. The angle of repose was calculated using the following formula:

$\tan \theta = h / r$ $\tan \theta$ = Angle of repose

h = Height of the cone , r = Radius of the cone base

Table 1: Angle of Repose values (as per USP)

Angle of Repose	Nature of Flow
<25	Excellent
25-30	Good
30-40	Passable
>40	Very poor

Bulk density:

Density is defined as weight per unit volume. Bulk density, is defined as the mass of the powder divided by the bulk volume and is expressed as gm/cm^3. The bulk density of a powder primarily depends on particle size distribution, particle shape and the tendency of particles to adhere together. Bulk density is very important in the size of containers needed for handling, shipping, and storage of raw material and blend. It is also important in size blending equipment. 10 gm powder blend was sieved and introduced into a dry 20 ml cylinder, without compacting. The powder was carefully leveled without compacting and the unsettled apparent volume, Vo, was read.

The bulk density was calculated using the formula:

Bulk Density = M / V_o

Where, M = weight of sample

V_o = apparent volume of powder

Tapped density:

After carrying out the procedure as given in the measurement of bulk density the cylinder containing the sample was tapped using a suitable mechanical tapped density tester that provides 100 drops per minute and this was repeated until difference between succeeding measurement is less than 2 % and then tapped volume, V measured, to the nearest graduated unit. The tapped density was calculated, in gm per L, using the formula:

Tap = M / V

Where, Tap= Tapped Density

M = Weight of sample

V= Tapped volume of powder

Measures of powder compressibility:

The Compressibility Index (Carr's Index) is a measure of the propensity of a powder to be compressed. It is determined from the bulk and tapped densities. In theory, the less compressible a material the more flowable it is. As such, it is measures of the relative importance of interparticulate interactions. In a free-flowing powder, such interactions are generally less significant, and the bulk and tapped densities will be closer in value.

For poorer flowing materials, there are frequently greater interparticle interactions, and a greater difference between the bulk and tapped densities will be observed. These differences are reflected in the Compressibility Index which is calculated using the following formulas:

Carr's Index = [(tap - b) / tap] × 100

Where, b = Bulk Density

Tap = Tapped Density

Table 2: Carr's index value (as per USP)

Carr's index	Properties
5 – 15	Excellent
12 – 16	Good
18 – 21	Fair to Passable
2 – 35	Poor
33 – 38	Very Poor
>40	Very Very Poor

Formulation development of floating Tablets:

Procedure for direct compression method:

1) Drug and all other ingredients were individually passed through sieve no ≠ 60.
2) All the ingredients were mixed thoroughly by triturating up to 15 min.
3) The powder mixture was lubricated with talc.
4) The tablets were prepared by using direct compression method by using 10 mm punch.

FORMULATION OF TABLETS:

Table 3: Formulation composition for Floating tablets

Ingredients (mg)	FORMULATION CHART								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Fenoverine	100	100	100	100	100	100	100	100	100
Carbopol	25	50	75	-	-	-	-	-	-
HPMC K 100	-	-	-	30	60	90	-	-	-
Ethyl Cellulose	-	-	-	-	-	-	50	100	150
Sodium bicarbonate	15	15	15	15	15	15	15	15	15
Citric acid	10	10	10	10	10	10	10	10	10
Aerosil	4	4	4	4	4	4	4	4	4
Mg Stearate	5	5	5	5	5	5	5	5	5
MCC	241	216	191	236	206	176	216	166	116
Total weight	400	400	400	400	400	400	400	400	400

All the quantities were in mg

Evaluation of post compression parameters for prepared Tablets

The designed compression tablets were studied for their physicochemical properties like weight variation, hardness, thickness, friability and drug content.

Weight variation test:

To study the weight variation, twenty tablets were taken and their weight was determined individually and collectively on a digital weighing balance. The average weight of one tablet was determined from the collective weight. The weight variation test would be a satisfactory method of deter mining the drug content uniformity. Not more than two of the individual weights deviate from the average weight by more than the percentage shown in the following table and none deviate by more than twice the percentage. The mean and deviation were determined. The percent deviation was calculated using the following formula.

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

Table 4: Pharmacopoeial specifications for tablet weight variation

Average weight of tablet (mg) (I.P)	Average weight of tablet (mg) (U.S.P)	Maximum percentage difference allowed
Less than 80	Less than 130	10
80-250	130-324	7.5
More than	More than 324	5

Hardness:

Hardness of tablet is defined as the force applied across the diameter of the tablet in order to break the tablet. The resistance of the tablet to chipping, abrasion or breakage under condition of storage transformation and handling before usage depends on its hardness. For each formulation, the hardness of three tablets was determined using Monsanto hardness tester and the average is calculated and presented with deviation.

Thickness:

Tablet thickness is an important characteristic in reproducing appearance. Tablet thickness is an important characteristic in reproducing appearance. Average thickness for core and coated tablets is calculated and presented with deviation.

Friability:

It is measured of mechanical strength of tablets. Roche friabilator was used to determine the friability by following procedure. Pre weighed tablets were placed in the friabilator. The tablets were rotated at 25 rpm for 4 minutes (100 rotations). At the end of test, the tablets were re- weighed, and loss in the weight of tablet is the measure of friability and is expressed in percentage as

% Friability = [(W1-W2) / W1] × 100

Where, W1 = Initial weight of tablets

W2 = Weight of the tablets after testing

Determination of drug content:

Both compression-coated tablets of were tested for their drug content. Ten tablets were finely powdered quantities of the powder equivalent to one tablet weight of Fenoverine were accurately weighed, transferred to a 100 ml volumetric flask containing 50 ml water and were allowed to stand to ensure complete solubility of the drug. The mixture was made up to volume with water. The solution was suitably diluted and the absorption was determined by UV –Visible spectrophotometer. The drug concentration was calculated from the calibration curve.

***In vitro* Buoyancy studies:**

The *in vitro* buoyancy was determined by floating lag time, and total floating time. (As per the method described *by Rosa et al*) The tablets were placed in a 100ml beaker containing 0.1N HCL. The time required for the tablet to rise to the surface and float was determined as floating lag time (FLT) and duration of time the tablet constantly floats on the dissolution medium was noted as Total Floating Time respectively (TFT).

***In vitro* drug release studies**

Dissolution parameters:

Apparatus	--	USP-II, Paddle Method
Dissolution Medium	--	0.1 N HCL
RPM	--	50
Sampling intervals (hrs)	--	0.5,1,2,3,4,5,6,7,8,9,10,11,12
Temperature	--	37°c $\pm$ 0.5°c

As the preparation was for floating drug release given through oral route of administration, different receptors fluids are used for evaluation the dissolution profile.

Procedure:

900ml of 0.1 HCL was placed in vessel and the USP apparatus –II (Paddle Method) was assembled. The medium was allowed to equilibrate to temp of 37°c $\pm$ 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 0.5 to 12hrs 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 media and analyzed by spectrophotometrically at 253 nm using UV-spectrophotometer.

Application of Release Rate Kinetics to Dissolution Data:

Various models were tested for explaining the kinetics of drug release. To analyze the mechanism of the drug release rate kinetics of the dosage form, the obtained data were fitted into zero-order, first order, Higuchi, and Korsmeyer-Peppas release model.

Zero order release rate kinetics:

To study the zero–order release kinetics the release rate data ar e fitted to the following equation.

$F = K_o t$

Where, 'F' is the drug release at time't', and 'K_o' is the zero order release rate constant. The plot of % drug release versus time is linear.

First order release rate kinetics: The release rate data are fitted to the following equation

$Log (100-F) = kt$

A plot of log cumulative percent of drug remaining to be released vs. time is plotted then it gives first order release.

Higuchi release model: To study the Higuchi release kinetics, the release rate data were fitted to the following equation.

$F = k\, t1/2$

Where, 'k' is the Higuchi constant.

In higuchi model, a plot of % drug release versus square root of time is linear.

Korsmeyer and Peppas release model:

The mechanism of drug release was evaluated by plotting the log percentage of drug released versus log time according to Korsmeyer- Peppas equation. The exponent 'n' indicates the mechanism of drug release calculated through the slope of the straight Line.

$$M_t/ M_\infty = K\, t^n$$

Where, M_t/ M_∞ is fraction of drug released at time 't', k represents a constant, and 'n' is the diffusional exponent, which characterizes the type of release mechanism during the dissolution process. For non-Fickian release, the value of n falls between 0.5 and 1.0; while in case of Fickian diffusion, n = 0.5; for zero-order release (case I I transport), n=1; and for super case II transport, n > 1. In this model, a plot of log (M_t/ M_∞) versus log (time) is linear.

RESULTS AND DISCUSSION

Drug – Excipient compatibility studies

Fourier Transform-Infrared Spectroscopy:

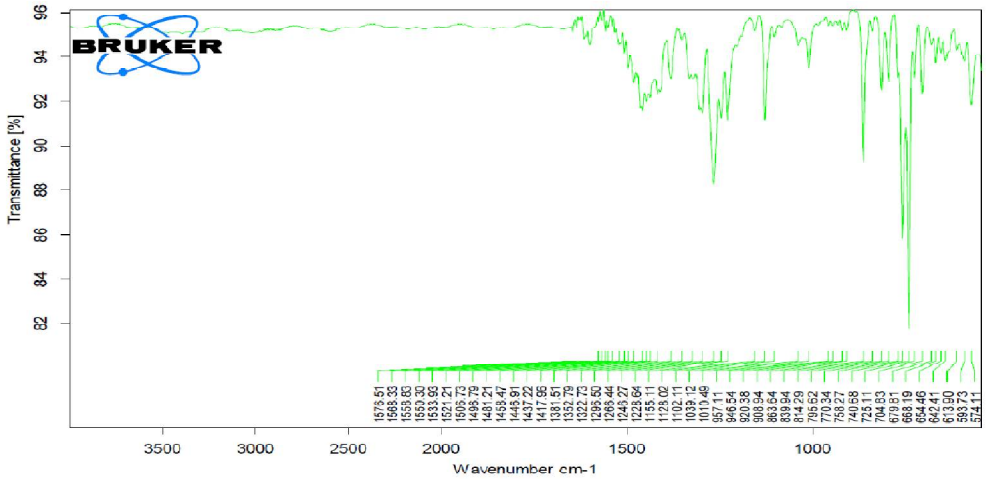

Figure 1: FTIR Spectrum of pure drug

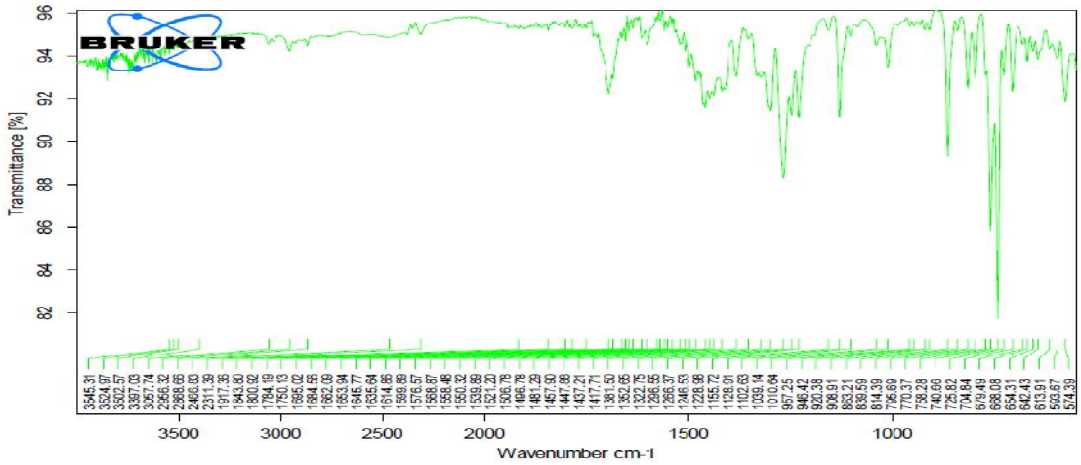

Fig 2 FTIR Spectrum of Drug and all excipients mixture

There was no disappearance of any characteristics peak in the FTIR spectrum of drug and the polymers used. This shows that there is no chemical interaction between the drug and the polymers used. The presence of peaks at the expected range confirms that the materials taken for the study are genuine and there were no possible interactions.

Fenoverine is also present in the physical mixture, which indicates that there is no interaction between drug and the polymers, which confirms the stability of the drug.

Analytical Method

A. Determination of absorption maxima

The standard curve is based on the spectrophotometry. The maximum absorption was observed at 258 nm.

B. calibration curve

Graphs of Fenoverine was taken in 0.1N HCL (pH 1.2)

Table no 5: Observations for graph of Fenoverine in 0.1N HCL

Conc [µg/mL]	Abs
0	0
5	0.137±0.04
10	0.264±0.05
15	0.387±0.07
20	0.511±0.09
25	0.627±0.03

All the values represent as mean±SD n=3

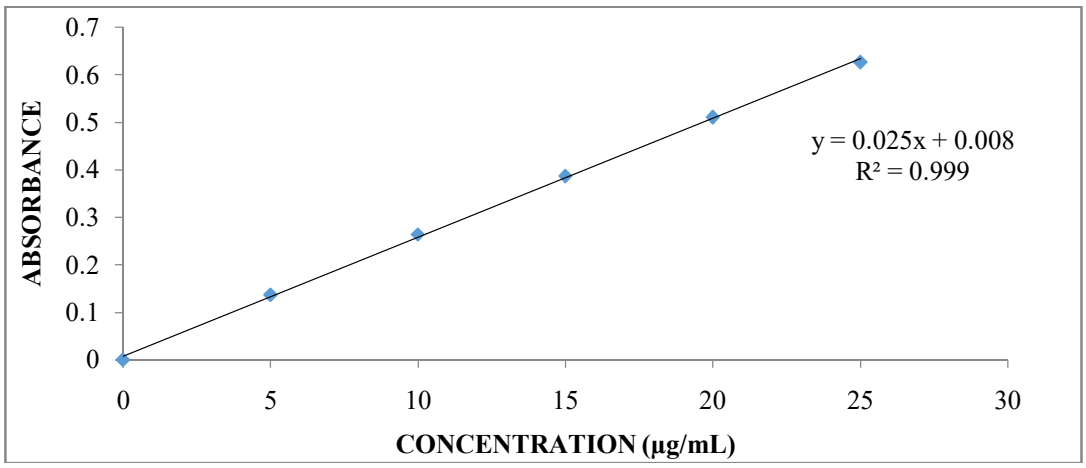

Fig 3 Standard graph of Fenoverine in 0.1N HCL

Standard graph of Fenoverine was plotted as per the procedure in experimental method and its linearity is shown in Table 5 and Fig 3. The standard graph of Fenoverine showed good linearity with R^2 of 0.999, which indicates that it obeys "Beer- Lamberts" law.

Preformulation parameters of powder blend:

Table 6: Pre-formulation parameters of blend

Formulation Code	Angle of Repose	Bulk density (gm/mL)	Tapped density (gm/mL)	Carr's index (%)	Hausner's Ratio
F1	18.8±1.13	0.38±0.03	0.43±0.05	11.6±0.10	1.13±0.03
F2	19.6±1.06	0.39±0.05	0.44±0.06	11.3±0.55	1.12±0.02
F3	19.4±0.95	0.42±0.07	0.47±0.02	10.6±0.09	1.11±0.05
F4	21.9±0.55	0.40±0.09	0.45±0.01	11.1±0.08	1.12±0.06
F5	17.5±0.96	0.41±0.05	0.46±0.07	10.8±0.11	1.12±0.09
F6	19.2±0.79	0.37±0.06	0.43±0.09	13.9±0.12	1.16±0.05
F7	19.5±1.15	0.38±0.07	0.46±0.05	17.3±0.22	1.21±0.07
F8	21.3±1.30	0.39±0.03	0.45±0.08	13.3±0.15	1.15±0.04
F9	20.1±1.22	0.41±0.02	0.45±0.03	8.8±0.09	1.09±0.02

Tablet powder blend was subjected to various pre-formulation parameters. The angle of repose values indicates that the powder blend has good flow properties. The bulk density of all the formulations was found to be in the range of 0.37 to 0.42 (gm/ml) showing that the powder has good flow properties. The tapped density of all the formulations was found to be in the range of 0.43 to 0.47 showing the powder has good flow properties. The compressibility index of all the formulations was found to be below 17.3 which show that the powder has good flow properties. All the formulations has shown the hausners ratio ranging between 1.09 to 1.21 indicating the powder has good flow properties.

Quality Control Parameters For tablets:

Tablet quality control tests such as weight variation, hardness, and friability, thickness, Drug content and drug release studies were performed for floating tablets.

Table 7*: In vitro* quality control parameters

Formulation codes	Average Weight (mg)	Weight Variation	Hardness (kg/cm²)	Friability (%loss)	Thickness (mm)	Drug content (%)	Floating lag time (sec)	Total Floating Time(Hrs)
F1	399.32	Pass	5.1±0.24	0.36±0.04	5.21±0.02	98.62± 0.44	52	7
F2	400.12	Pass	4.6±0.39	0.54±0.03	5.69±0.04	99.35± 0.75	46	8
F3	398.91	Pass	4.1±0.48	0.41±0.01	5.72±0.09	100.01±0.92	38	10
F4	396.82	Pass	5.2±0.22	0.65±0.02	5.24±0.06	98.41± 0.44	49	9
F5	399.58	Pass	4.8±0.36	0.54±0.03	5.36±0.03	99.20± 0.92	21	10
F6	400.25	Pass	4.9±0.35	0.39±0.05	5.68±0.05	99.03±0.36	38	10
F7	399.31	Pass	5.3±0.46	0.57±0.06	5.76±0.07	98.16±0.81	35	5
F8	398.85	Pass	4.6±0.22	0.75±0.02	5.12±0.04	98.34±0.43	29	7
F9	397.42	Pass	5.4±0.25	0.34±0.01	5.53±0.06	99.16±0.75	25	9

All the parameters such as weight variation, friability, hardness, thickness, drug content were found to be within limits.

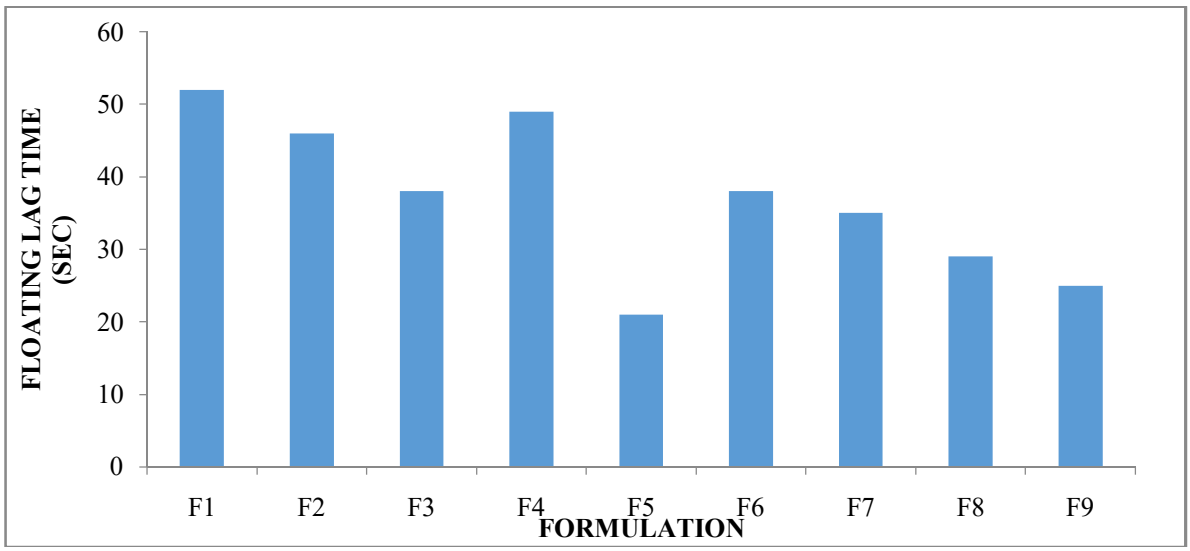

Figure 4: Floating lag time (sec)

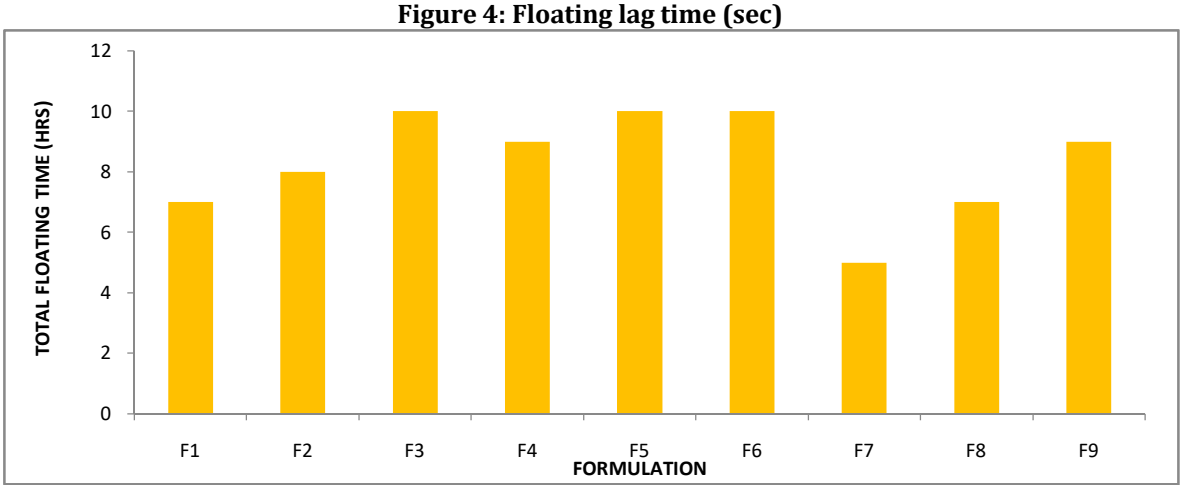

Figure 5: Total Floating Time (Hrs)

***In Vitro* Drug Release Studies**

Table no 8: Dissolution data of Floating Tablets

Time	F1	F2	F3	F4	F5	F6	F7	F8	F9
0	0	0	0	0	**0**	0	0	0	0
1	16.62±0.77	13.58±0.43	11.05±0.39	09.41±0.19	**14.83±0.24**	10.39±0.13	25.19±0.58	18.96±0.18	15.38±0.55
2	29.68±0.36	21.64±0.25	16.31±0.58	12.34±0.27	**18.10±0.33**	15.17±0.25	39.72±0.45	24.83±0.57	20.29±0.23
3	35.64±0.46	27.11±1.14	22.65±0.82	20.92±0.36	**28.01±0.37**	23.35±0.37	43.93±0.33	31.78±0.22	26.71±0.45
4	41.48±0.77	38.97±0.55	30.19±1.09	26.76±0.34	**34.65±0.48**	30.17±0.95	59.54±0.43	37.41±0.63	31.92±0.75
5	56.95±0.85	53.65±0.92	36.64±0.55	30.63±0.56	**41.34±0.52**	36.86±0.23	65.41±0.56	45.79±0.75	36.49±0.66
6	68.72±0.59	62.74±0.74	45.39±0.85	35.21±0.74	**48.89±0.87**	42.61±0.35	79.76±0.74	51.86±0.34	42.58±0.69
7	79.39±0.85	74.22±1.25	56.41±1.24	47.34±0.43	**56.14±0.67**	49.14±0.66	86.19±0.43	67.31±0.59	58.26±0.33
8	83.14±0.63	85.94±0.41	59.87±0.35	65.27±0.86	**57.60±0.93**	55.59±0.79	98.72±0.55	73.22±0.88	70.15±0.37
9	97.58±0.21	94.19±0.84	64.16±0.89	79.34±0.74	**68.19±0.55**	63.61±0.82	-	81.89±0.76	77.87±0.20
10	-	98.76±0.22	77.52±0.53	85.27±0.55	**79.26±0.67**	70.34±0.74	-	97.15±0.27	85.62±0.90
11	-	-	85.97±0.77	96.54±0.10	**92.57±0.36**	82.23±0.69	-	-	88.48±0.11
12	-	-	92.26±0.23	-	**99.96±0.14**	89.45±0.23	-	-	-

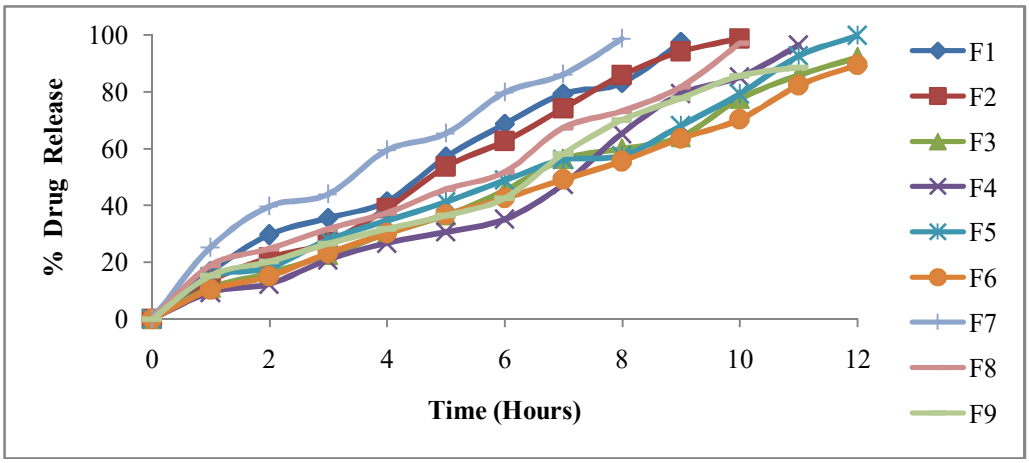

Fig:6 Dissolution data of Fenoverine Floating tablets

From the dissolution data it was evident that the formulations prepared with Carbopol as polymer were retarded the drug release more than 12 hours.

Whereas the formulations prepared with HPMC K 100 retarded the drug release up to 12 hours in the concentration 60 mg. In higher concentrations the polymer was unable to retard the drug release.

From the dissolution data, it was revealed that formulations prepared with Ethyl Cellulose retard the drug release up to 12 hrs.

Hence from the above dissolution data it was concluded that F5 formulation was considered as optimised formulation because good drug release (99.96%) in 12 hours.

Application of Release Rate Kinetics to Dissolution Data for optimised formulation:

Table No 9: Application kinetics for optimised 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
14.83	1	1.000	1.171	0.000	1.930	14.830	0.0674	-0.829	85.17	4.642	4.400	0.242
18.1	2	1.414	1.258	0.301	1.913	9.050	0.0552	-0.742	81.9	4.642	4.343	0.299
28.01	3	1.732	1.447	0.477	1.857	9.337	0.0357	-0.553	71.99	4.642	4.160	0.482
34.65	4	2.000	1.540	0.602	1.815	8.663	0.0289	-0.460	65.35	4.642	4.028	0.614
41.34	5	2.236	1.616	0.699	1.768	8.268	0.0242	-0.384	58.66	4.642	3.886	0.756
48.89	6	2.449	1.689	0.778	1.709	8.148	0.0205	-0.311	51.11	4.642	3.711	0.930
56.14	7	2.646	1.749	0.845	1.642	8.020	0.0178	-0.251	43.86	4.642	3.527	1.115
57.6	8	2.828	1.760	0.903	1.627	7.200	0.0174	-0.240	42.4	4.642	3.487	1.155
68.19	9	3.000	1.834	0.954	1.503	7.577	0.0147	-0.166	31.81	4.642	3.169	1.473
79.26	10	3.162	1.899	1.000	1.317	7.926	0.0126	-0.101	20.74	4.642	2.747	1.894
92.57	11	3.317	1.966	1.041	0.871	8.415	0.0108	-0.034	7.43	4.642	1.951	2.690
99.96	12	3.464	2.000	1.079	-1.398	8.330	0.0100	0.000	0.04	4.642	0.342	4.300

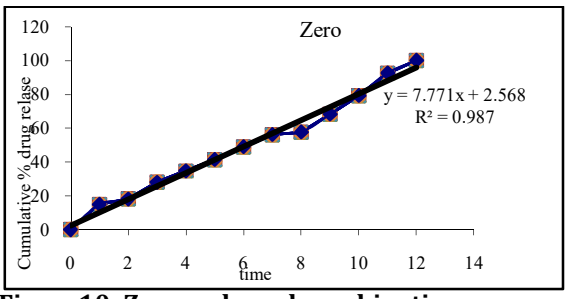

Fig no 10: Zero order release kinetics

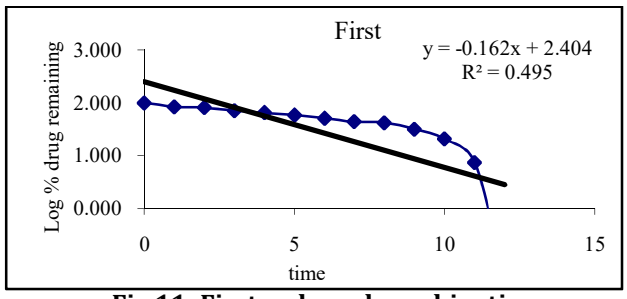

Fig 11: First order release kinetics

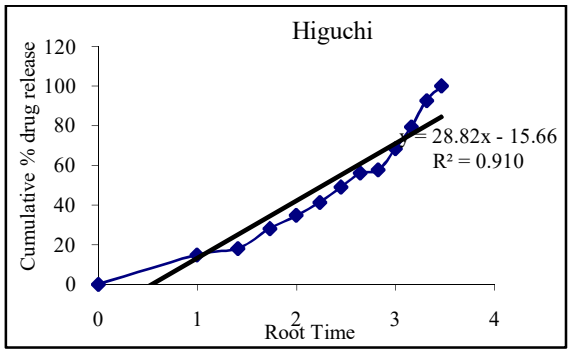

Fig no 12: Higuchi release kinetics

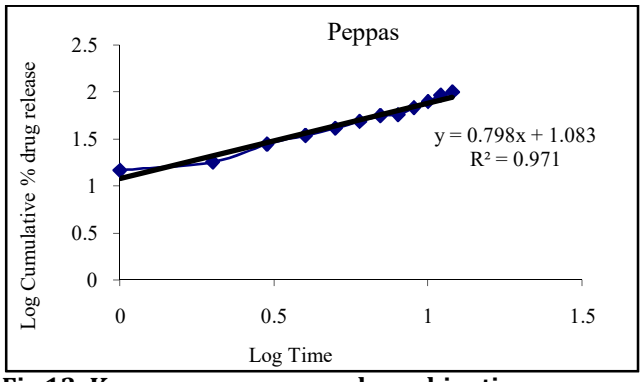

Fig 13: Kors mayer peppas release kinetics

Optimised formulation F5 was kept for release kinetic studies. From the above graphs it was evident that the formulation F5 was followed Zero order release kinetics and following Korsmeyer peppas mechanism with regression value of 0.971 and n value was found to be 0.798 which indicates it follows non fickian drug release pattern.

CONCLUSION

This study discusses the preparation of effervescent floating tablet of Fenoverine. Fenoverine tablets were successfully prepared by direct compression method using different types of polymers Carbopol, HPMC K 100 and Ethyl Cellulose. The prepared tablets of Fenoverine were evaluated tablet hardness, uniformity of weight, friability, uniformity of content, *in vitro* buoyancy test and *in vitro* dissolution study. All the compositions were resulted in adequate Pharmacopoeial limits. Compatibility studies was execution during FTIR shown that there was absence of probable chemical interaction between pure drug and excipients. The varying concentration of gas generating agent and polymers was found to affect on *in-vitro* drug release and floating lag time. *In vitro* drug release of floating gastro retentive tablet of Fenoverine shown that the formulation F5 was found to be the best formulation as it releases 99.96% Fenoverine in a controlled manner for an extended period of time (up to 12hrs). The release data was fitted to various mathematical models such as Higuchi, Korsmeyer-Peppas, First order and Zero order to evaluate the kinetics and mechanism of the drug release. The optimized formulation (F5) was followed Zero order release kinetics and following Korsmeyer peppas mechanism with regression value of 0.971 and n value was found to be 0.798 which indicates it follows non fickian drug release pattern.

Prepared floating tablets of Fenoverine may prove to be a potential candidate for safe and effective controlled drug delivery over an extended period of time for gastro retentive drug delivery system.

Floating tablets have emerged as the power full means of improving the bioavailability and providing sustained release and avoiding the adverse effects of many drugs. Floating tablets have proved to be potential approach for gastric retention. These systems have special advantage for the drug that is primarily absorbed from the upper part of GIT. So with an improved knowledge of formulation development aspect, physiochemical and pharmacological prospects of drug there is lot of future scope for designing of optimum floating drug delivery system.

ACKNOWLEDGEMENT

The Authors are thankful to the Management and Principal, Department of Pharmacy, Deccan School of Pharmacy, Hyderabad for extending support to carry out the research work. Finally, the authors express

their gratitude to the Sura Labs, Dilsukhnagar, Hyderabad, for providing research equipment and facilities.

REFERENCES

1. Leon Lachman, Herbert A. Liberman, (2000). The Theory And Practice Of Industrial Pharmacy: P.293-302.
2. Robinson Jr, Lee V.H.L, (1978). Controlled Drug Delivery: Fundamentals And Applications, 2nd Edn. Marcel Dekker, New York: (1978) P.24-36.
1. Brahmankar D.M, Jaiswal S.B, (1995). Biopharmaceutics And Pharmacokinetics A Treatise, 1st Ed. Vallabh Prakashan; New Delhi: P.64-70.
2. Chein Y.W, (1992). Novel Drug Delivery Systems, 2nd Ed.: Marcel Dekker; New York: (1992) P.4-56.
3. Ansel R. (2009). Pharmaceutical Dosage Form And Drug Delivery System, Lipincott, 7th Edition: P. 553.
4. Gennaro R.A. Remington, (2000). The Science And Practice Of Pharmacy., 20th Ed. New York: Lippincott Williams: P.1045.
5. Banker G.S, Rhodes C.T, (1996). Modern Pharmaceutics. 3rd Ed. Marcel Dekker, New York: P.678-721.
6. Vyas S.P, Khar R.K, (2002). Controlled Drug Delivery: Concepts And Advances, 1st Ed. Vallabh Prakashan, New Delhi: P.345-376.
7. Shweta Arora,(2005). Floating Drug Delivery: A Review, Aaps Pharmscitech. 47(11); P.268-272.
8. Libo Yang, A New Intragastric Delivery System For The Treatment Of H.Pylori Associated With Gastric Ulcers, Elsevier J. Of Controlled Release., Apr(1999): 34 (5); P. 215-222.
9. Ross and Wilson, (2013). Anatomy Physiology And Health Education. 9th Ed. Churchil Livingston, P. 295-311.
10. Wilson K.R.W, Waugh A. (1996). Anatomy And Physiology In Health And Illness, 9th Ed. Churchill Livingstone: London: P. 342-345.
11. Garima Chawla- (2003). A Means To Address Regional Variability In Intestinal Drug Absorption: Pharmtech., P.234-238.
12. Chawla G, Gupta P, Koradia V, Bansal A, (2003). Gastroretention: A Means To Address Regional Variability In Intestinal Drug Absorption, Pharm. Tech., P.50-68.
13. Desai S, Bolton S. (1993). A Floating Controlled Release System: In-Vitro And In-Vivo Evaluation, J. Pharm. Res.,: 10; P.1321-1325.
14. Garg S, Sharma S. (2003). Gastroretentive Drug Delivery Systems, Pharmatech, P.160-164.
15. Jose, Khalid Shah, (2003). Gastroretentive Drug Delivery System, Business Brief, Pharmtech., 3[2] P. 165-173.
16. Deshpande A.A, Shah N.H, Rhodes C.T, (1997). Development Of A Novel Controlled Release System For Gastric Retention, J. Pharm. Res.,: 14(6); P. 815-819.
17. Garima Chawla- A Means To Address Regional Variability In Intestinal Drug Absorption: Pharmtech., (2003) P.234-238.
18. David S.S. (1986). The Effect Of Density On The Gastric Emptying On Single And Multiple Unit Dosage Forms. J. Pharm Res., 3; P.208-213.
19. Ramya Sri Sura And Pavani S. (2014). Formulation And Evaluation Of Bioadhesive Buccal Tablets Of Mosapride Citrate. World Journal Of Pharmaceutical Research. 3(10): 1545-76.
20. Ramya Sri Sura, CVS Subrahmanyam, Shyam Sunder Rachamalla. Design And Evaluation Of Liquisolid Compacts Of Nebivolol Hydrochloride (2022). Design And Evaluation Of Liquisolid Compacts Of Nebivolol Hydrochloride. International Journal Of Applied Pharmaceutics., 14(2), 293-307.
21. Ramya Sri Sura, Subrahmanyam CVS , Shyam Sunder Rachamalla. (2021). Development And Evaluation Of Self Micro Emulsifying Drug Delivery System (SMEDDS) For Nebivolol Hydrochloride. Int. J. Life Sci. Pharma Res. 11(6), P83-97. Http://Dx.Doi.Org/10.22376/ijpbs/lpr.2021.11.6.P83-97

CITATION OF THIS ARTICLE

Gulam M A, Shahid M, Abdul M, Ramya Sri. S. Formulation and Evaluation of Floating Fenoverine Tablets. Bull. Env. Pharmacol. Life Sci., Vol 12[7] June 2023: 164-174.