Formulation And Evaluation of Furosemide Floating Tablet

Miss. Disha vilas kale[1], Mr.Babasaheb L. Chopade[2], Dr. Megha T. Salve[3]
[1, 2, 3]Dept of Pharmacy
[1, 2, 3,]Shivajirao Pawar College of Pharmacy, Pachegaon, Tq. Newasa,
Dist.Ahmednagar, Maharashtra,India

Abstract- *By overcoming physiological challenges such short gastric residence periods (GRT) and unpredictably long stomach emptying times, rate controlled oral medication delivery devices have recently made scientific and technological strides (GET). Several methods are now used to extend the GRT, including delayed gastric emptying devices such as swelling and expanding systems, polymeric bio adhesive systems, modified-shape systems, high-density systems, and floating drug delivery systems (FDDS), also known as hydrodynamically balanced systems (HBS). The two approaches are taken in the development of FDDS by creating both effervescent and non-effervescent floating tablets with a buoyancy mechanism as its foundation. Drugs with limited solubility and higher pH levels can be delivered by FDDS because they have a restricted window for absorption in the upper gastrointestinal system, are unstable in the lower intestine environment, and have local activity. The physiological and formulation factors that affect gastric retention time are included in the most recent advancements in floating drug delivery systems. Additionally, approaches to formulating single-unit and multiple-unit floating systems, as well as their classification and formulation aspects, are covered in detail. The application of floating drug delivery devices and the evaluation criteria are also summarised in this paper.*

By integrating IoT with efficient waste segregation mechanisms, this project aims to revolutionize waste management in metro stations, promoting environmental sustainability and hygiene

Keywords- Floating Tablets, Control Drug Release, Patient Compliance, Improved Bioavailabilty.

I. INTRODUCTION

Mechanism of Floating System

The medicine is slowly released from the system at the desired rate while floating on the gastric contents. The stomach residual system is emptied after the medication has been released. For the buoyancy retention principle to be properly achieved, however, a minimum degree of floating force (F) is also necessary to maintain the dose form consistently buoyant on the surface of the meal. A novel method for calculating the resultant weight has been described in the literature as a way to measure the kinetics of the floating force. The device works by continually measuring the force F (expressed as a function of time) needed to keep the submerged object in place. If F is higher on the positive side, the object floats better.[5]

GASTROINTESTINAL INTENSION

Advantages of Floating Drug Delivery

1. Some drugs' bioavailability, like that of riboflavin, and levodopa) CR-GRDF is substantially more effective than the administration of CR polymeric compositions that are not GRDF.
2. Drugs with a short biological half-life may experience flip-flop pharmacokinetics, which lowers the dose frequency. This is also possible with drugs when FDDS input is slow and continuous. These characteristic increases patient compliance, which enhances the therapy.
3. For local therapy in the stomach, the prolonged and sustained delivery of the medication from FDDS may be helpful.
4. Slow drug absorption into the body reduces counter activity, increasing drug effectiveness.
5. The pre-systemic metabolism of the tested drug may be massively improved when the medication is supplied to the metabolic enzymes (cytochrome P-450, in particular, CYP- 3A4) in a sustained way.

1.2.6 Disadvantages of Floating Drug Delivery

1. These systems need a lot of fluid in the stomach to float and function properly when delivering drugs.
2. Unsuitable for medications with GIT solubility or stability issue

3. It would not be advisable to take drugs like nifedipine, which is well absorbed throughout the GIT and undergoes first-pass metabolism.
4. Drugs that irritate the stomach mucosa are also not preferred or appropriate.

MATERIAL AND METHOD

Table 3 List of material

Sr.no.	Material	Company Name
1	Furosemide	Balaji chemical pvt. Ltd, Gandhinagar Gujrat
2	HPMC K4M	Swapnavat Chemical Agency, Aurangabad
3	Sodium Bicarbonate	Swapnavat Chemical Agency, Aurangabad
4	PVP K30	Adora Product Pvt. Ltd. Aurangabad
5	Magnesium stearate	Adora Product Pvt. Ltd. Aurangabad
6	Talc	Swapnavat Chemical Agency Aurangabad
7	Avicel Ph 101	Adora Product Pvt. Ltd. Aurangabad

Table 4 List of equipment used

Sr.no	Equipment	Manufacture	Model no.
1	UV-VIS Spectrophotometer	Jasco	V-630
2	Electronic Balance	Shimadzu, Japan.	BL-220H
3	Rotary Tableting Machine	Karnavati	Rimek Minipress-1
4	FTIR Spectrophotometer	Jasco	FT/IR-4600
5	Friability Test Apparatus	Electrolab, India	ELECTROLAB
6	Vernier Calipers	Indolabs, Chennai	-
7	Dissolution Test Apparatus	Shimadzu, Japan.	60-PLUS
8	Hardness Test Apparatus	Sohamm calibration service	-
9	Differential scanning calorimetry	Shimadzu, Japan.	TA60WS

FORMULATION OF FUROSEMIDE FLOATING TABLETS

Furosemide tablets were prepared by direct compression method. All the ingredients weigh accurately and pass through sieve no. 44 The drug with other powders was mixed for 10 min in a polythene bag followed by the addition of magnesium stearate and further mixed for 5 min. 200 mg of the mixture was weighed and fed manually in the die of a tablet punch machine and directly compressed. In this way nine formulations were designed, containing the different ratios of three polymers, and tablets were evaluated for various parameters and find out the best formulation. The composition of floating tablets of Furosemide was shown in the table below Table 6.

Table 5 Composition of Furosemide floating tablets

Ingredients	F1	F2	F3	F4	F5
Furosemide (mg)	40	40	40	40	40
HPMC K4M (mg)	55	70	70	70	70
Sodium Bicarbonate (mg)	50	25	50	50	25
PVP K30 (mg)	4	4	4	10	10
Magnesium Stearate (mg)	4	4	4	4	4
Talc (mg)	6	6	6	6	6
Avicel PH 101 (mg)	Q.S	Q.S	Q.S	Q.S	Q.S
Total mg)	200	200	200	200	200

PRE-FORMULATION STUDY

Physical characteristics of furosemide:

The physical characteristics of furosemide were found to be colour was white and the odour was odourless.

Melting Point of Furosemide:

The melting point of Furosemide was found to be 205°c

IDENTIFICATION AND CHARACTERIZATION OF DRUGS AND EXCIPIENTS BY FT-IR.

FT-IR spectra of pure drug Furosemide and Furosemide with HPMC:

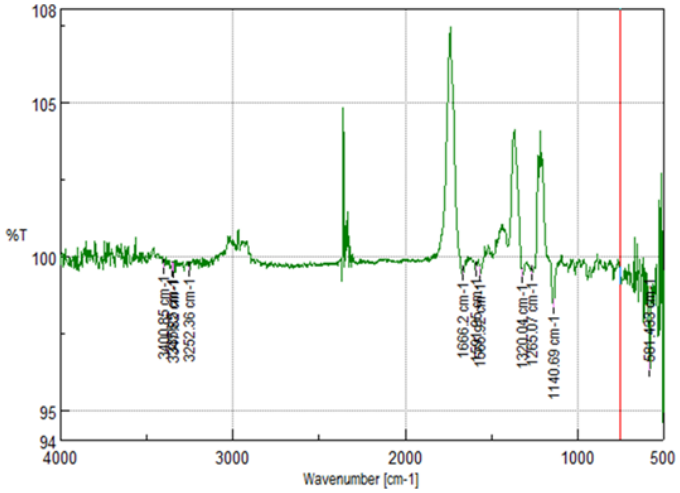

Figure FT-IR spectrum of pure drug Furosemide

U.V SPECTROPHOTOMETRIC ANALYSIS:

Determination of λmax and Calibration curve of Furosemide in 0.1 N HCL:

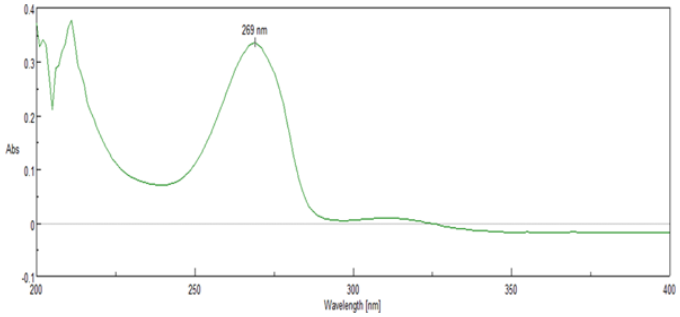

Fig. λmax of Furosemide in 0.1N HCL

The absorption spectra in the range (200-400nm) were obtained for Furosemide in 0.1N HCL. The drug exhibited an absorption maximum of 269 nm.

Construction of calibration curve of Furosemide in 0.1N HCL:

Table 11 Conc. and absorbance of Furosemide in 0.1N HCL

Sr. No.	Conc. µg/ mL	Absorbance at 269 (nm)
1.	2	0.418
2.	4	0.4613
3.	6	0.552
4.	8	0.6813
5.	10	0.7901

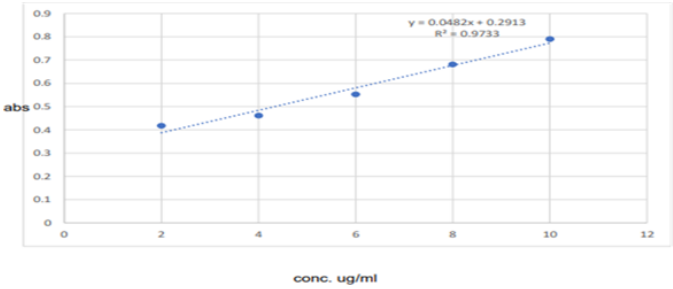

Fig. Calibration curve of Furosemide in 0.1N HCL

Table 15 Solubility Determination

Sr.no.	Ingredient	Solubility mg/ml
1	Distilled Water	0.1
2	Methanol	50
3	Ether	8
4	Chloroform	0.98

EVALUATION OF FLOATING TABLETS OF FUROSEMIDE

Pre-Compression Parameters:

The powder value's bulk density is used to determine the compressibility index and Hausner ratio. The compressibility index of all formulations indicates a good flow property in Table 18.

Table 18 Pre-Compression parameters

Formulation	Parameter				
	LBD (gm/ml)	TBD (gm/ml)	Compressibility Index (%)	Angle of Repose	Hausner Ratio (%)
F1	0.55	0.66	16.06%	26.57	1.2
F2	0.54	0.62	12.9%	27.30	1.14
F3	0.53	0.63	15.8%	25.40	1.16
F4	0.55	0.64	14.06%	28.2	1.16
F5	0.51	0.60	15.%	26.3	1.17

Post-Compression Parameters:

Formulation	Parameter				
	Weight Variation (%)	Thickness (mm)	Hardness (kg/cm²)	Friability (%)	Drug Content (%)
F1	1.01	6.01	5.20	0.58	97.30
F2	1.41	6.24	5.69	0.79	97.20
F3	1.21	6.69	5.79	0.45	96.10
F4	1.65	6.54	5.21	0.55	95.30
F5	1.21	6.22	5.21	0.65	98.40

FLOATING TEST

When the tablet containing the effervescent ingredient comes into touch with the acidic medium (0.1 N HCl), carbon dioxide is produced inside the tablet. The tablets floated and stayed buoyant after being submerged in 0.1 N HCl at 37°C. The floating lag time results for all nine formulas in one minute. The F2 and F9 formulas have more than 13 hours of combined floating time.

Table 20 Floating parameter

Formulation	Parameter	
	Floating lag time (sec)	Total floating time (Hrs.)
F1	70	10 Hrs.
F2	65	13 Hrs. 15 min.
F3	80	9 Hrs. 55 min
F4	60	11 Hrs. 30 min.
F5	58	12 Hrs.

SWELLING STUDY

The swelling ratio, which depends on the network structure, hydrophilicity, and ionization of the functional groups, defines the water volume in the hydrogel at equilibrium. For eight hours, a swelling investigation was conducted on each batch. According to the study, tablet swelling increased for all formulations for up to 4-5 hours before it started to decline. The swelling index data are shown in Table 21 whereas the swelling index against the time plot shows an increase over time as a result of the polymer's hydrophilicity gradually absorbing water. A gel barrier is created at the outside surface of the polymer's top layer as it hydrates, expands, and swells. The hydration swelling release process is repeated towards new tissues as the gelatinous layer gradually dissolves and/or is disseminated.

Table 21 Swelling index

Time (Hrs.)	Swelling index %				
	F1	F2	F3	F4	F5
1	34.68	30.14	45.36	44.25	49.50
2	51.21	47.33	55.69	58.65	62.65
3	61.45	54.83	68.25	69.25	80.65
4	71.56	65.44	76.24	75.45	88.95
5	87.45	78.33	85.69	82.36	86.26
6	75.65	55.42	59.78	55.98	63.11
7	52.25	39.22	36.20	35.45	33.15
8	28.36	27.93	30.45	29.21	17.20

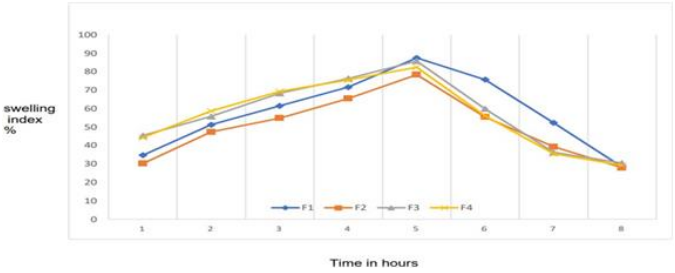

Fig. Swelling index of F1 to F4

IN-VITRO DISSOLUTION STUDIES

Time (hrs.)	Cumulative % drug release				
	F1	F2	F3	F4	F5
1	30.41	28.29	28.65	29.83	29.40
2	41.25	36.45	38.20	35.45	38.71
3	52.79	42.42	45.90	45.21	55.26
4	68.98	49.42	57.36	52.23	69.30
5	80.95	57.69	65.28	58.65	79.35

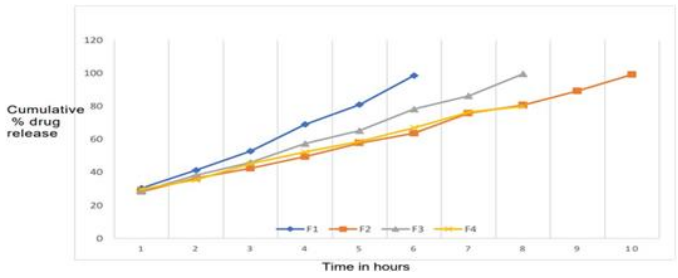

Fig. Cumulative % drug release of F1 to F4

VIII. CONCLUSION

- Hydrodynamically balanced tablets of Furosemide can be formulated with an approach to increase gastric residence and thereby improve drug bioavailability.
- An attempt to develop floating tablets of Furosemide by using sodium bicarbonate as a gas- generating agent and HPMC as a hydrophilic polymer by direct compression the technique was achieved.
- The formulated tablets showed compliance for various physiochemical parameters viz. tablet dimensions, total floating time, tablet density, and drug content.
- The dissolution studies formulations of F8 and F9 were good release and the F2 formulation was excellent.

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