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Design And Evaluation Of Non-Effervescent Floating Matrix Tablets Of Raltegravir Potassium For Controlled Release

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ABSTRACT : The present research focuses on the formulation and evaluation of non-effervescent floating matrix tablets of Raltegravir Potassium intended for controlled drug release. Raltegravir, an integrase strand transfer inhibitor used in HIV therapy, exhibits optimal absorption in the upper gastrointestinal tract, making it a suitable candidate for gastro-retentive delivery. Floating matrix tablets were prepared using hydrophilic polymers such as HPMC K15M, HPMC K100M and Xanthan gum in varying concentrations. The formulations were evaluated for physicochemical properties, in-vitro buoyancy, drug release, release kinetics, and stability. Optimized formulations demonstrated prolonged floating time, controlled drug release up to 12 hours and stability under accelerated conditions. A combination of these polymers produced favorable results. F13 formulation showing the highest effectiveness in all aspects . This study offers valuable insights into the formulation and characterization of a controlled drug delivery system for Raltegravir Potassium using these hydrophilic polymers, In conclusion, swelling polymers like xanthan gum, HPMC K15M, and HPMC K100M have proven effective in formulating controlled-release floating tablets of Raltegravir.

KEYWORDS : Raltegravir Potassium, Floating drug delivery system, Non-effervescent tablets, Controlled release, HPMC,Xanthan gum

INTRODUCTION

Drug Delivery encompasses the comprehensive processof administering a pharmaceutical compound to produce a therapeutic outcome in humans or animals. This focuses on various methods and techonoligies aimed at enhancing the absorption,distribution,metabolism,and execration of medication.(1) Oral drug administration is the process of taking medication by mouth for absorption into the bloodstream through the gastrointestinal tract.it is the most common and preferred route due to its convenience,safety,cost-effectiveness and high patient compliance.(2) A Controlled Release Drug Delivery System is a method of administering medications that carefully controls both the timing and rate of release of the active ingredient in the body. This approach aims to keep drug levels within a therapeutic range over a prolonged period, providing consistent efficacy and reducing the risk of side effects linked to variations in drug concentration.(3,4,5,6). A Floating Drug Delivery System (FDDS) is a specialized pharmaceutical formulation developed to remain buoyant on the gastric fluids in the stomach for an extended duration. This floating ability enables the system to stay in the stomach longer and gradually release the drug, extending its residence time. FDDS usually consists of lowdensity materials or matrices that support

buoyancy while not disrupting normal gastrointestinal processes.(7)Controlled Release Floating Matrix Syatem is a specialized pharmaceutical formulation designed to remain buoyant on gastric fluids while delivering drugs in a controlled, prolonged manner. This system embeds drugs within a matrix of polymers or hydrocolloids thatswell and become buoyant upon contact with gastric fluids.(8)

Significance of controlled release floating matrix system:

Controlled Release Floating Matrix Systems fulfill several critical needs in pharmaceutical formulations. They are designed to prolong the residence time of drugs in the stomach, ensuring optimal absorption and bioavailability. By regulating the release kinetics of drugs, these systems maintain therapeutic levels in the bloodstream, minimizing the need for frequent dosing and enhancing patient adherence to treatment. These systems enable targeted drug delivery to specific gastrointestinal sites, reducing systemic side effects while offering versatility in formulation to meet diverse clinical needs.

The development of Controlled Release Floating Matrix Systems continues to drive innovation in drug delivery, supporting advancements in pharmaceutical research and expanding treatment options for various medical conditions.(9)

Effervescent Tablets: Effervescent tablets are formulated to dissolve in water, releasing carbon dioxide gas and creating a fizzy solution. This effervescence aids in the quick dispersion and absorption of active ingredients. These tablets typically contain acids and bicarbonates, which react when mixed with water to produce the fizzing effect. They are popular for their rapid onset of action and ease of use.(10)

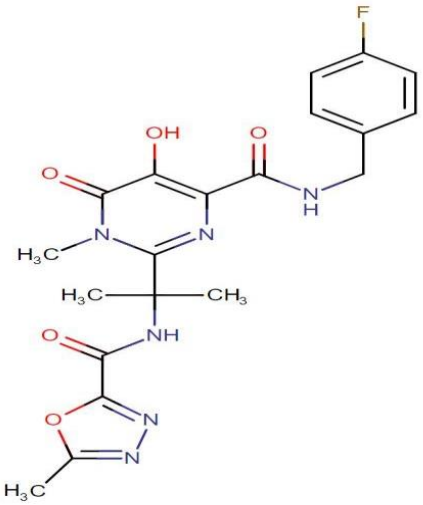
Non Effervescent Tablets: Non-effervescent tablets, in contrast, do not generate gas or fizz upon contact with water or other liquids. These tablets are formulated for controlled or sustained release of the active ingredients over time. Different polymers and excipients are used in their composition to regulate the release rate of the drug, enhancing patient adherence. Noneffervescent tablets are often favored for their stability and ability to provide prolonged therapeutic effect.(11)

MATERIALS AND METHODS

Drug Profile

Raltegravir Potassium, approved by the FDA in 2007, is an integrase strand transfer inhibitor (INSTI) used to treat HIV/AIDS. It works by blocking HIV1 integrase, which prevents the viral DNA from integrating into the host genome, effectively stopping viral replication. With its unique mechanism of action, minimal toxicity, and excellent tolerability due to its selective targeting of viral enzymes, Raltegravir Potassium has become a key therapeutic option for both newly diagnosed and treatment experienced patients, including those with HIV strains resistant to other drugs .(12,13,14,15)

Structure of Raltegravir potassium



S.NO	MATERIALS	PURPOSE
1.	Raltegravir potassium	API
2.	HPMC K 15M	Synthetic polymer
3.	HPMC K 100M	Synthetic polymer
4.	Xanthum gum	Natural polymer
5.	MCC	BIinder/Diluent
6.	Talc	Lubricant
7.	Magnesium Stearate	Lubricant

Tab:1 Materials used for formulation

METHODOLOGY

1.Construction of Standard Calibration Curve of Raltegravir Potassium :A calibration curve for Raltegravir Potassium was developed using 0.1 N HCl as the solvent. Standard solutions with concentrations ranging from 10 to 100 µg/ml were prepared and absorbance was measured at 250 nm using a UV spectrophotometer.

2. Fourier Transform Infrared (FT-IR):

The KBr disk sample preparation technique (pressed pellet technique) was used to obtain the IR spectra of the samples on an IR spectrophotometer. The infrared spectra of pure drug, pure drug and excipient blend were recorded by using a Fourier transform infrared spectrophotometer. A baseline correction was made using dried potassium bromide and then the spectrum of the pure drug. Approximately 100 mg of potassium bromide was mixed with one mg of the test sample. The scanning range was selected between 4000 and 600 cm-1. The obtained spectra were compared with those reported in official compendia. Characteristic peaks attributable to functional groups present in a molecule of each drug were assigned to establish the identity.

3. Procedure for Preparation of Floating Raltegravir Tablets

Floating matrix tablets containing Raltegravir were prepared using the direct compression technique with various concentrations of different polymer grades.

Method

Direct Compression Method

Accurately Raltegravir Potassium and other ingredients were weighed , then pass them through sieve no. 40.

Raltegravir Potassium was mixed thoroughly with the required amounts of HPMC K15M, HPMC K100M, and Xanthan gum, then blend with the remaining ingredients in geometric proportions.

Lubricate the blended mixture with previously weighed and sieved magnesium stearate and talc to prepare it for compression. Compress the lubricated blend using an 8 mm standard flat-faced circular punch on a rotary tablet punching machine.

EVALUATION TESTS

1.General Appearance
2.Hardness test
3.Friability test
4.Weight variation test
5.Estimation of drug content
6.Stability Studies data

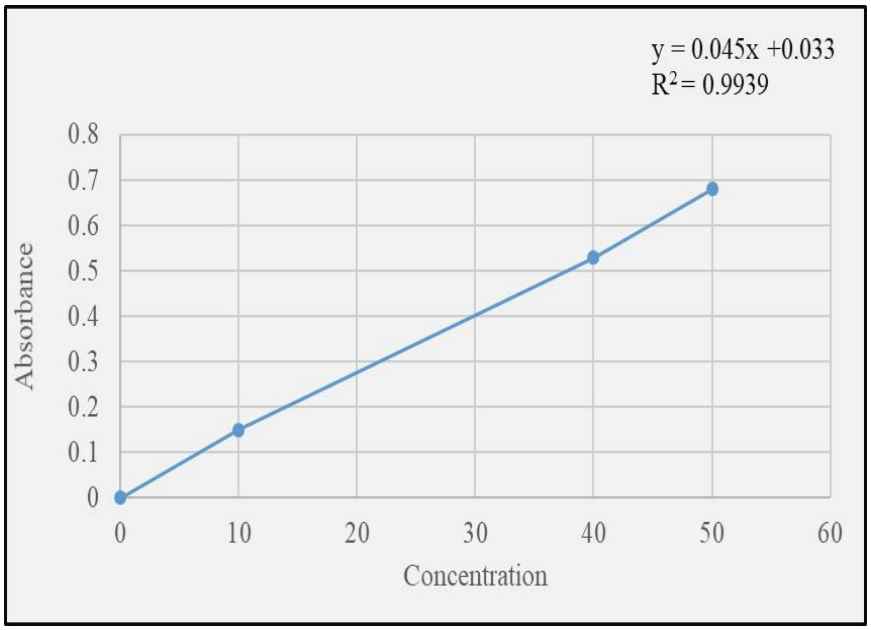
In-vitro dissolution studies: The in vitro dissolution studies were performed using USP type II dissolution apparatus at 50rpm. Dissolution test was carried out for a total period of 12 h using 0.1N HCl (pH 1.2) solution (900 ml) as dissolution medium at 37 ± 0.5° for first 2h, and pH 6.8phosphate buffer solution (900 ml) for the rest of the period. An aliquot (5ml) was withdrawn at specific time intervals and replaced with fresh medium to maintain a constant volume. The samples were filtered, and analyzed by UV spectrophotometer at 239 nm. The concentration was calculated using standard calibration curve.

RESULTS AND DISCUSION:

Standard Calibration Curve for Raltigravir Potassium Pure raltegravir was first scanned within the UV range of 200 to 400 nm, revealing maximumabsorbance at 250 nm. Standard solutions of raltegravir, with concentrations from 10 to 100µg/ml,were prepared in 0.1 N HCl, and absorbance was recorded at 250 nm. Raltegravir demonstrated good linearity in the range of 10 to 60 µg/ml, showing a high correlation coefficient.

Concentration (µg/ml)	**Absorbance**
0	0
10	0.150
20	0.221
30	0.372
40	0.529
50	0.68
60	0.75

Tab:1 Standard Calibration Curve for Raltegravir Potassium



Graph 1 Standard Calibration Curve for Raltegravir Potassium

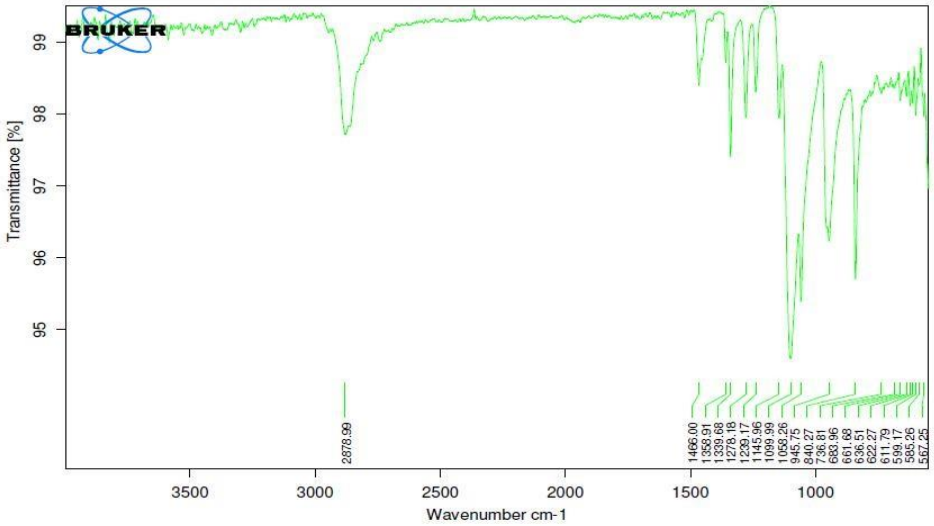
FTIR Studies:

The FTIR spectra of Raltegravir, HPMC K15M, HPMC K100M, and Xanthum Gum individually exhibit their characteristic functional group vibrations. In the combined formulation, the spectra show the retention of Raltegravir's key peaks (notably the carbonyl stretch at ~1700 cm^{-1}), along with the broad O–H bands of the polymers. No new peaks or major peak shifts were observed, indicating the absence of chemical interactions or degradation. Minor broadening in the O–H region suggests possible hydrogen bonding, confirming physical compatibility among Raltegravir, HPMC K15M, HPMC K100M and Xanthum Gum.

Functional Group	**Expected Peak (cm^{-1})**	**Interpretation**
O–H / N–H stretch	3300–3200	Hydrogen bonding, heterocyclic N–H
Aromatic C–H	~3050	Aromatic ring vibration
Aliphatic C–H	2950–2850	CH_3 / CH_2
C=O stretch (amide/ketone)	~1700 (strong)	Diagnostic peak of Raltegravir
C=N / C=C stretch	1600–1500	Heteroaromatic system
C–O stretch	1200–1100	Ester / ether C–O

Tab 2 FTIR characterization of Pure drug

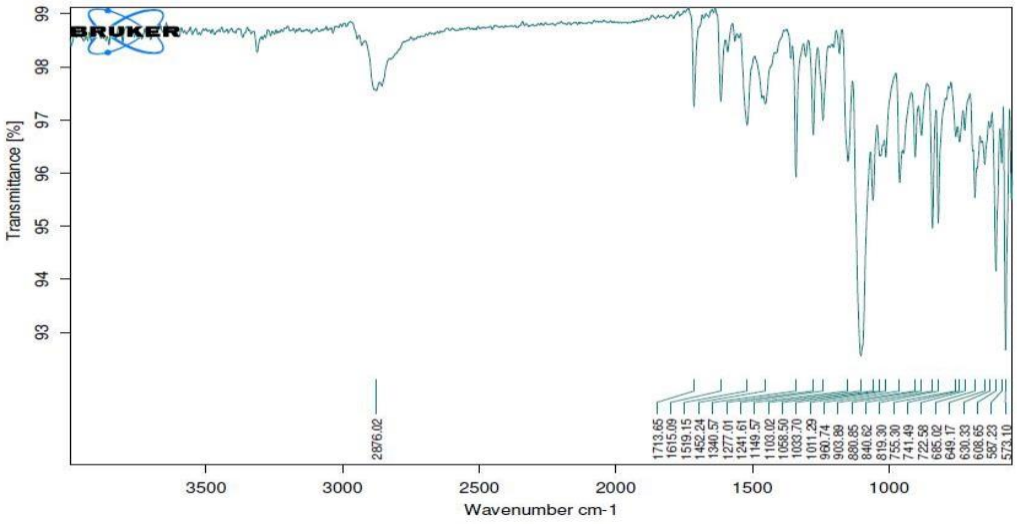
Absence of new functional group peaks confirms no chemical incompatibility



FTIR Spectra of Pure drug (Raltegravir Potassium)

Functional Group	Peak (cm^{-1})	Notes
Very broad O–H stretch	3500–3200	Polymer hydroxyl groups
C–H stretch	2970–2870	Methyl & Methylene
C–H bending	1450–1350	Polymer backbone
C–O–C stretch (ether)	1150–1050	Strong characteristic peak

Tab:3 FTIR characterizations of pure drug and polymers



FTIR Spectra of Raltegravir Potassium+HPMC K15M+HPMC K100M+Xanthan gum This spectrum helps determine drug–polymer compatibility.

Expected Observations:

✔ O–H region (3500–3200 cm^{-1}) Broad band from both polymers dominates.

Raltegravir's N–H/O–H overlaps here.

Minor broadening → physical hydrogen bonding, no chemical reaction. ✓Carbonyl region (~1700 cm^{-1})

Raltegravir's C=O MUST remain visible.

Xanthan also contributes carboxylate peaks (1720–1600).

Slight shifts ≤10 cm^{-1} indicate weak interactions, but no degradation.

✔ C–O–C region (1150–1000 cm^{-1})

Strong peaks from HPMC and Xanthan dominate.

Drug peaks become less intense — normal due to polymer dilution.

✔ NO new peaks

Optimized formula From the FTIR data is was evident that the drug and excipient does not have any interactions. Hence they were compatible.

Dissoluation studies of the formulation

Prototype Raltegravir Potassium with HPMC K 100M

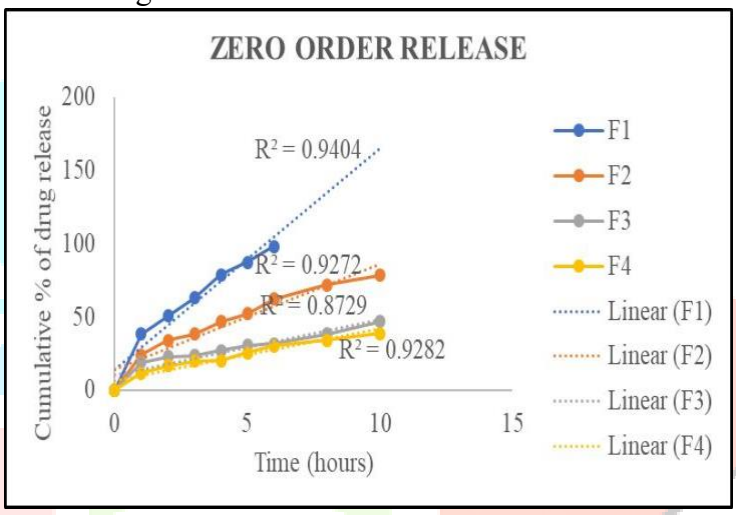
Ingredient	**F1 mg**	**F2 mg**	**F3 mg**	**F4 mg**
Raltegravir Potassium	100	100	100	100
HPMC K 100M	25	50	75	100
MCC PH 200	20	20	20	20
Talc	3.5	3.5	3.5	3.5
Magnesium Stearate	1.5	1.5	1.5	1.5
TOTAL WEIGHT	150	175	200	225
EVALUATION PARAMETERS				
Weight Variation	150 ±0.83	175 ±0.85	200 ± 0.95	225 ± 0.97
Tablet Hardness	4.5	5.3	5.9	6.6
Tablet Diameter	7	7	7	7
Thickness	3.23	3.57	4.14	4.50
Friability	0.45	0.28	0.42	0.47
Drug Content (%)	97.33	96.5	94.01	95.25
In-vitro Buoyancy	> 20 sec	> 19 sec	> 15 sec	> 17 sec

Tab:4 Formulation Development of Raltegravir Potassium with HPMC K 100M Floating matrix tablets containing Raltegravir were prepared using HPMC K 100M. The drug, HPMC K 100M, and MCC were blended together and passed through a 30-mesh sieve. This blend was pre-lubricated with talc and then further lubricated with magnesium stearate. The final mixture was compressed using an 8 mm flat-faced punch, resulting in tablets with a hardness range of 4.5 to 6.1 kg/cm². and friability below 1%, indicating adequate tablet strength. In vitro buoyancy studies showed that the tablets began floating within 15 seconds.

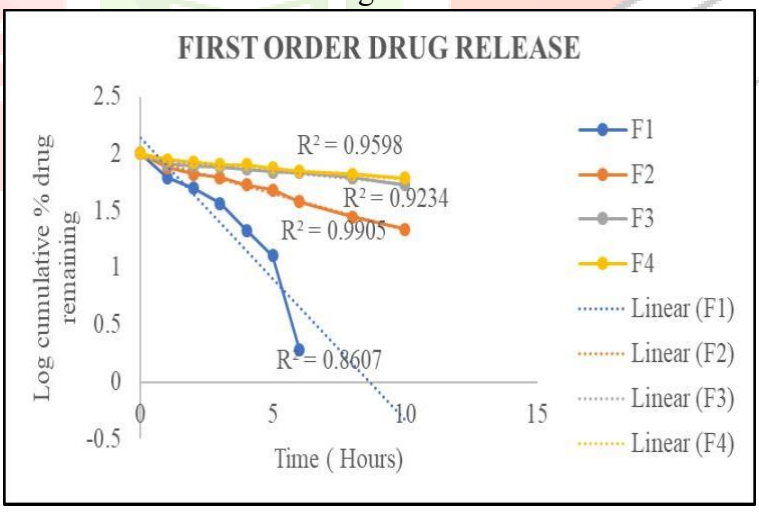
In-vitro drug release studies of Raltegravir Potassium floating matrix tablets prepared with HPMC K 100M: In-vitro dissolution studies for the formulated matrix tablets were performed in 900 ml of 0.1 N HCl using a USP Type II apparatus at a controlled temperature of 37 ± 0.5°C, lasting approximately 10 hours. Results showed that the matrix tablets sustained drug release for over 10 hours. In formulation F4, with a polymer ratio of 44%, only 37% of the drug was released over the 10-hour period, indicating that a higher polymer ratio delayed drug release. Kinetic analysis of drug release revealed that the formulation followed zero-order kinetics, showing that the release rate was independent of drug concentration. The correlation coefficient for the Higuchi model ranged from 0.994 to 0.986, suggesting a diffusion-controlled mechanism. A summary of the in vitro dissolution and release kinetics for the Raltegravir floating matrix tablets is provided in the accompanying table and figure.

Time (hr)	Formulation			
	F1	F2	F3	F4
0	0	0	0	0
1	38.2	24.1	18.9	11.8
2	50.5	34	23	16.7
3	63.2	38.5	23.8	19.9
4	78.8	47	27.3	20.2
5	87.2	52.1	30.7	25.5
6	98.1	62.2	31.82	30.2
8		72	38.28	33.9
10		78.3	46.7	38.8

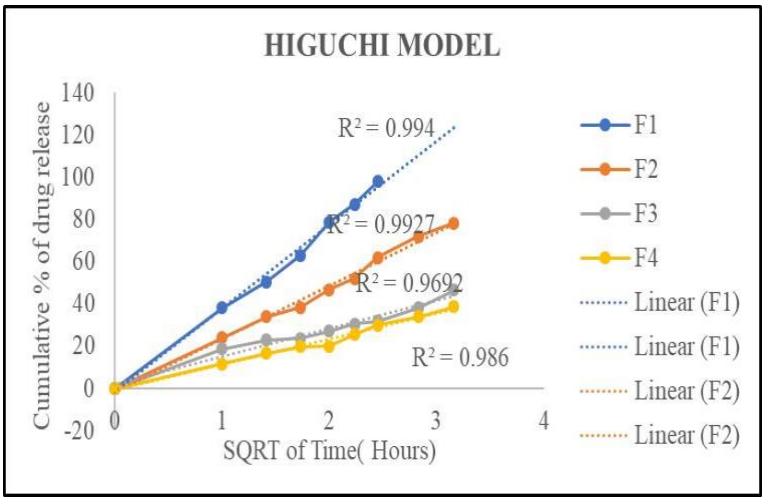
Tab:5 Dissolution studies of Raltegravir Potassium with HPMC K 100M



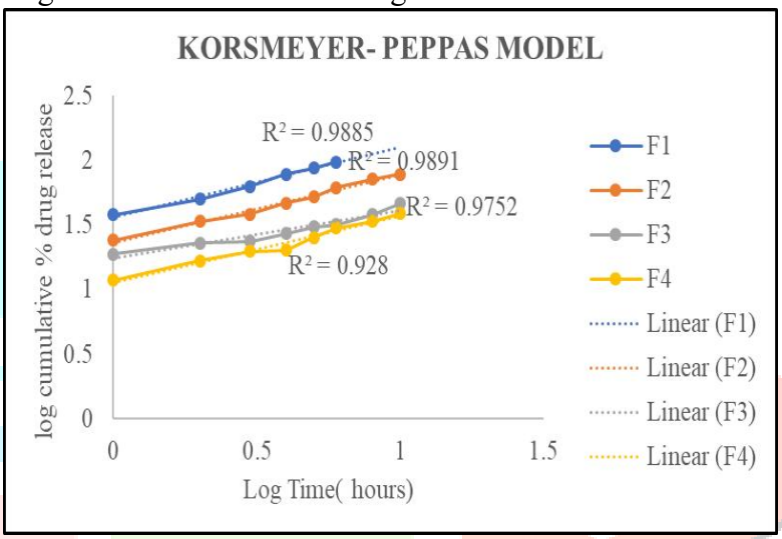
Graph 2 Zero order release of Raltegravir Potassium with HPMC K 100M



Graph 3 First order release of Raltegravir Potassium with HPMC K 100M



Graph 4 Higuchi order release of Raltegravir Potassium with HPMC K 100M



Graph 5 Korsemeyer peppas model release of Raltegravir Potassium with HPMC K 100M

Kinetics	F1	F2	F3	F4
Zero order (r2)	0.9404	0.9272	0.8729	0.9282
First order(r2)	0.8607	0.9905	0.9234	0.9598
Higuchi (r2)	0.994	0.9927	0.9692	0.986
peppas	0.9885	0.9891	0.9752	0.928

Tab 6 Release kinetics of F1,F2,F3, and F4

Prototype Raltegravir Potassium with HPMC K 15M

Ingredient	F5 mg	F6 mg	F7 mg	F8 mg
Raltegravir Potassium	100	100	100	100
HPMC K 15M	25	50	75	100
MCC PH 200	20	20	20	20
Talc	3.5	3.5	3.5	3.5
Magnesium Stearate	1.5	1.5	1.5	1.5
TOTAL WEIGHT	150	175	200	225
EVALUATION PARAMETERS				
Weight Variation	150 ± 1.12	175 ± 0.81	200 ± 0.77	225 ± 0.62
Tablet Hardness	5.6	5.1	5.9	6.2
Tablet Diameter	8	8	8	8
Thickness	3.2	3.55	3.6	4.12
Friability	0.55	0.88	0.75	0.82
Drug Content (%)	97.32	95.52	98.92	98.5
Invitro Buoyancy	>10 sec	>15 sec	>12 sec	>10 sec

Tab7Formulation Development of Raltegravir Potassium with HPMC K 15M

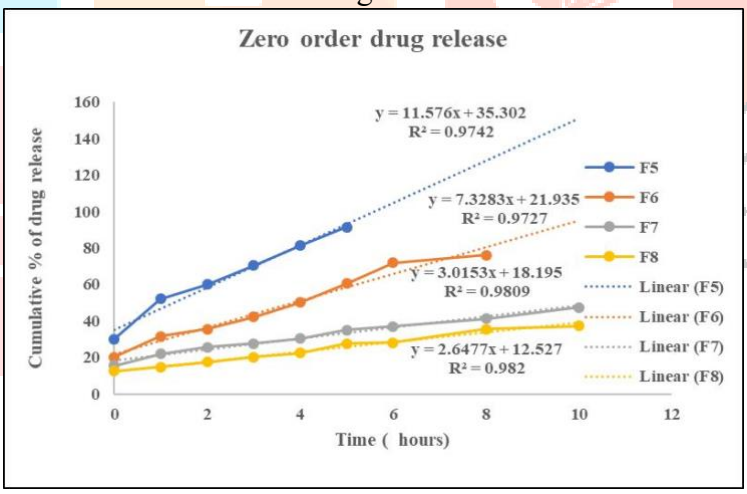
Tablets were compressed using an 8 mm flat-faced punch with a hardness of 5–6 kg/cm². The tablets underwent evaluation for various physicochemical parameters. The prepared formulation exhibited satisfactory physicochemical characteristics, with a hardness of 5–6 kg/cm² and a friability below 1%, indicating good tablet strength. Drug content was found to range from 97% to 98%, demonstrating uniform distribution of the drug within the matrix tablets. In vitro buoyancy testing showed that the tablets began floating in under 20 seconds.

Invitro drug release studies of Raltegravir Potassium floating matrix tablets prepared with HPMC K 15M

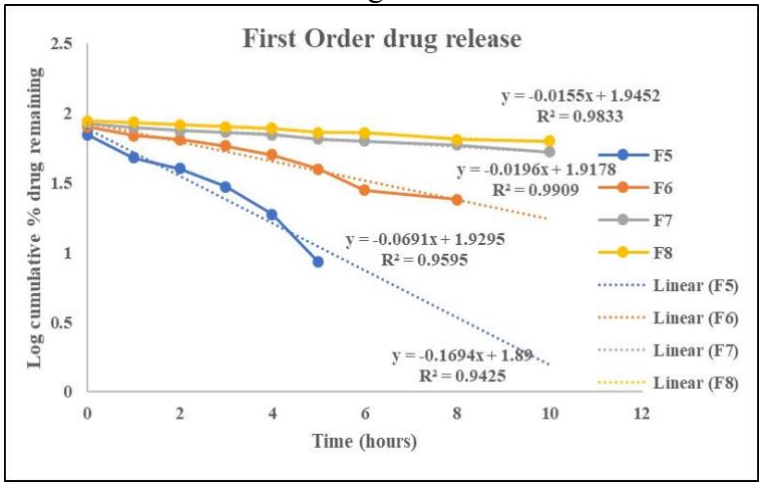
The in vitro dissolution studies demonstrated that drug release extended from 6 to 10 hours and beyond. For formulation F8, which included around 44% polymer, only 37% of the drug was released within 10 hours, indicating that a higher polymer content led to a delayed release. Analysis of drug release kinetics showed that the formulation followed a zero-order release pattern. The correlation coefficient for the Higuchi model ranged between 0.9729 and 0.902, suggesting a diffusion-controlled release mechanism.

Time		**Formulation**		
(hr)	F5	F6	F7	F8
0	0	0	0	0
1	30	20.2	15.5	12.5
2	52.2	31.5	21.8	14.7
3	60	35.5	25.5	17.5
4	70.5	42.2	27.5	20.3
5	81.25	50.1	30.2	22.5
6	91.5	60.5	35.1	27.7
8		72	41.2	35.5
10		76	47.5	37.2

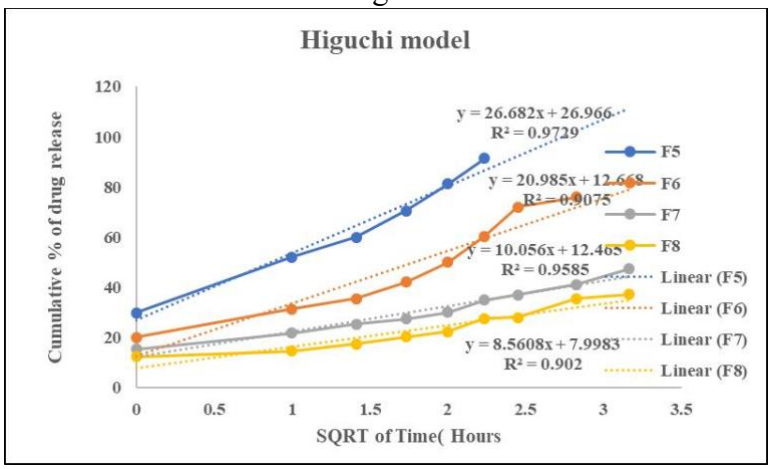
Tab 8 Dissoluation studies of Raltegravir Potassium with HPMC K 15M



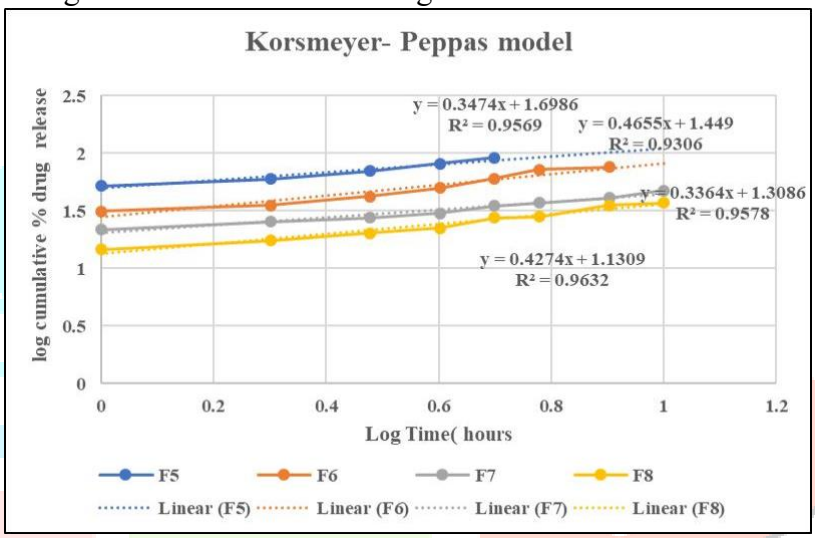
Graph 6 Zero order release of Raltegravir Potassium with HPMC K 15M



Graph 7 First order release of Raltegravir Potassium with HPMC K 15M



Graph 8 Higuchi order release of Raltegravir Potassium with HPMC K 15M



Graph 9 Korsemeyer peppas model of Raltegravir Potassium with HPMC K 15M

Kinetics	F5	F6	F7	F8
Zero order (r2)	0.9742	0.9727	0.9809	0.982
First order (r2)	0.9425	0.9595	0.9909	0.9833
Higuchi (r2)	0.9729	0.9075	0.9585	0.902
peppas	0.9569	0.9306	0.9578	0.9632

Tab 9 Release kinetics of F5,F6,F7 and F8

Prototype Raltegravir Potassium with Xanthan Gum

Ingredient	F9 mg	F10 mg	F11 mg	F12 mg
Raltegravir Potassium	100	100	100	100
Xanthum Gum	100	125	150	175
MCC PH 200	20	20	20	20
Talc	3.5	3.5	3.5	3.5

Magnesium Stearate	1.5	1.5	1.5	1.5
TOTAL WEIGHT	225	250	275	300
EVALUATION PARAMETERS				
Weight Variation	225 ± 1.44	250 ± 0.5	275 ± 0.44	300 ± 1.54
Tablet Hardness	4.7	5.3	6.6	6.8
Tablet Diameter	8	8	9	9
Thickness	5.6	5.3	6.12	6.35
Friability	0.25	0.23	0.47	0.5
Drug Content (%)	97.3	95.5	96.5	99.8
Invitro Buoyancy	>10 sec	>15 sec	>13 sec	>11 sec

Tab 10 Formulation Development of Raltegravir Potassium with Xanthan Gum

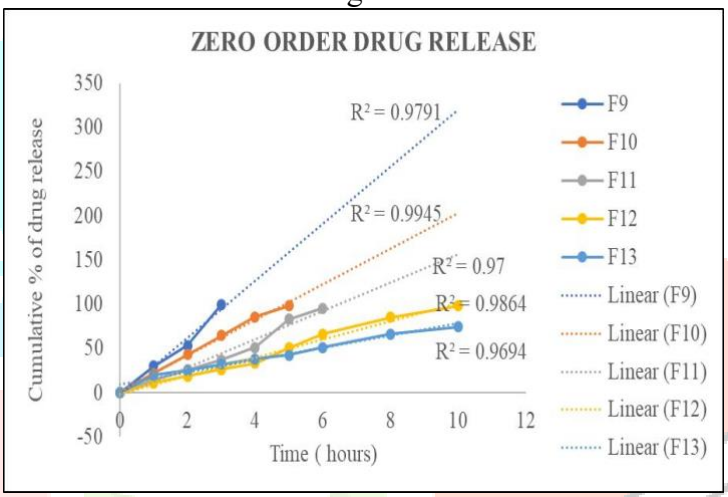
Matrix tablets of Raltegravir Potassium were formulated with different concentrations of xanthan gum. The drug, xanthan gum, and MCC PH200 were mixed uniformly through direct blending. This mixture was initially lubricated with talc, followed by a final lubrication with magnesium stearate. The final mixture was compressed using an 8 mm flat-faced punch for formulations F9 and F10, and a 9 mm flat-faced punch for F11 and F12.

The Raltegravir floating matrix tablets containing xanthan gum (F9 to F12) were evaluated for several physicochemical properties, including weight variation, hardness, thickness, friability, and drug content. Tablets prepared with the 8 mm punch (F9 and F10) had hardness values between 4.7 and 5.3 kg/cm², whereas those compressed with the 9 mm punch (F11 and F12) exhibited hardness values ranging from 6.6 to 6.8 kg/cm². Friability below 1% indicated strong tablet integrity and content uniformity. In vitro buoyancy test showed that the tablets floated within 15 seconds, confirming excellent buoyancy properties.

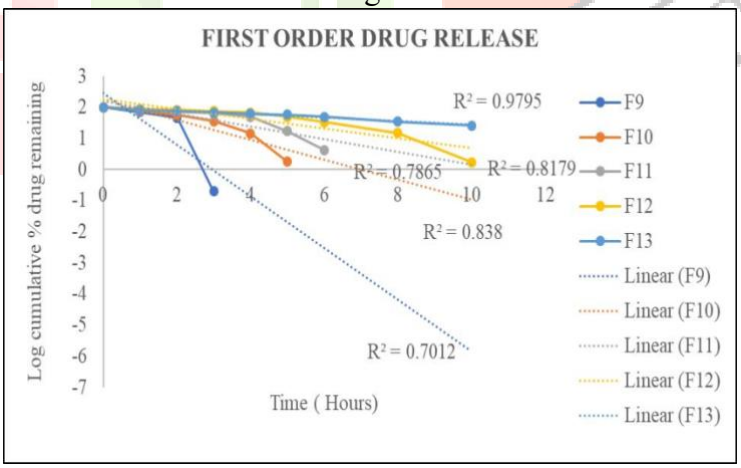
In-vitro Drug release studies of Raltegravir Potassium floating Matrix tablets prepared with xanthum gum: In vitro dissolution studies were conducted in 900 ml of 0.1 N HCl using a USP type II apparatus. Findings revealed that higher concentrations of xanthan gum in the polymer matrix slowed the drug release rate. All formulations demonstrated excellent floating capabilities. Formulation F9, with 44.44% xanthan gum, sustained drug release for only 3 hours.Formulation F10, containing 50% xanthan gum, extended the release to about 5 hours. Formulations F11 and F12, with xanthan gum concentrations of 54% and 58%, achieved drug release over 6 hours and 10 hours, respectively. Dissolution data for all formulations were analyzed using different kinetic models, including zero-order, first-order, Higuchi, and Peppas models. The release kinetics for all formulations followed a zero-order model, except for F9, which released the drug within 3 hours.

Time(hr)		Formulation		
	F9	F10	F11	F12
0	0	0	0	0
1	30.2	22.2	15	11.3
2	53.4	43.1	26	18.6
3	99.8	64.6	37	26.2
4		85.6	51	33.1
5		98.2	83	50.5
6			95.8	66.2
8				85.2
10				98.3

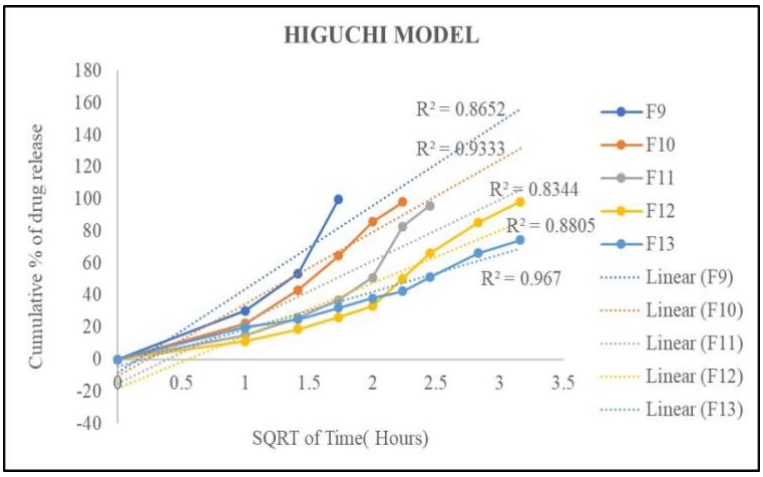
Tab 11 Dissolution studies of Raltegravir Potassium with Xanthum Gum



Graph 10 Zero order release of Raltegravir Potassium with Xanthum Gum



Graph 11 First order release of Raltegravir Potassium with Xanthum Gum



Graph 12 Higuchi model release of Raltegravir Potassium with Xanthum Gum

Kinetics	F9	F10	F11	F12
Zero order (r2)	0.9791	0.9945	0.97	0.9864
First order (r2)	0.7012	0.838	0.7865	0.8179
Higuchi (r2)	0.8652	0.9333	0.8344	0.8805
peppas	0.9691	0.9977	0.9697	0.9697

Tab 12 Kinetic studies of Raltegravir Potassium with Xanthum Gum

Prototype Raltegravir Potassium with HPMC K15M+HPMC K 100M+Xanthum Gum

Ingredient	F13 mg
Raltegravir Potassium	100
HPMC K15M	25
HPMC K100M	25
Xanthum Gum	100
MCC PH 200	20
Talc	3.5
Magnesium Stearate	1.5
TOTAL WEIGHT	275 gm
EVALUATION PARAMETERS	
Weight Variation	275 ± 5.5
Tablet Hardness	4.85
Tablet Diameter	8
Thickness	4.30
Friability	0.51

Drug Content (%)	99.98
Invitro Buoyancy	>25 sec

Tab 13 Formulation Development of Raltegravir Potassium with HPMC K 15M+HPMC K 100M+Xanthum Gum

Formulation Development of Raltegravir Potassium floating matrix tablets prepared with a combination of HPMC K15M, HPMC K 100M and xanthum gum

The formulation of Raltegravir matrix tablets was developed using a combination of polymers. Formulations containing a polymer proportion of 28.5% were selected, and this proportion of individual polymers was incorporated into the tablet formulation. The matrix tablets were prepared using the same method previously employed for individual polymers and were compressed using an 8mm round, flatfaced punch. These tablets were then evaluated for various physicochemical parameters, including weight variation, hardness, thickness, friability, and drug content. The tablets exhibited good physicochemical properties, with a drug content of 99.98%.

In vitro Drug release studies of Raltegravir Potassium floating Matrix tablets prepared with a combination of HPMC K15M, HPMC K 100M and Xanthum gum

In vitro dissolution studies revealed that drug release was more significantly delayed in the combination polymer formulation compared to the individual formulations F6 and F10. The drug release exhibited zero order kinetics with a correlation coefficient of 0.9694. According to Higuchi's correlation, the drug release mechanism was diffusion controlled. The Peppas release exponent 0.9788 values indicated that the release followed a nonFickian diffusion mechanism. Some formulations were selected from the floating matrix tablets prepared with xanthum gum, HPMC K15M, HPMC K 100M. The formulations releases above 74% in 10 hours. Were selected for the comparative study.

The F12 formulation, which contains 58.3% xanthan gum, released 98% of the drug over 10 hours. Compared to formulations made with other polymers and polymer mixtures, the drug release was slower for the first 4 hours. However, the release rate increased after the 5th hour and became faster in the later stages. The formulation with HPMC K15M alone released 89% of the drug in 10 hours, while the formulation with HPMC K100M released 79% of the drug in the same period. In these formulations, the drug release followed zero order kinetics. The in vitro buoyancy study was conducted for formulations F2, F6, F12, and F13. The tablets were placed in 100ml of 0.1N HCl contained in a 250ml beaker, and their floating time was observed. The matrix tablets prepared with xanthan gum floated for up to 8 hours. In contrast, tablets formulated with a combination of HPMC K15M, HPMC K100M, and xanthan gum remained buoyant for approximately 12 hours or more.

% Drug release **Time (hr)**	**F13**
0	0
1	20
2	25
3	32.2
4	38.1
5	42.3
6	51.2
8	66.1
10	74.3

Tab 14 Drug release profile of Combination of HPMC K 15M+HPMC K 100M+Xanthum Gum

Polymer used	HPMC K 100 M	HPMC K 15	Xanthum gum	Combination
	F2	F6	F12	F13
% Drug release	79%	89%	79%	95%
Zero order	0.9272	0.9727	0.9864	0.9694
1st Order	0.9905	0.9595	0.8179	0.9795
Higuchi	0.9927	0.9075	0.8805	0.967
Peppas	0.9891	0.9306	0.9697	0.9788

Tab 15 Drug release kinetics of formulation Combination of HPMC K 15M+HPMC K 100M+Xanthum Gum

Stability Studies of the best formulation: The release profile of the optimized formulation was found be similar as that of previous formulation.

% Drug release Time (hr)	F13
0	0
1	21
2	26
3	32.6
4	37.8
5	42.3
6	51.9
8	66.1
10	75.3

Tab 16 Stability studies –Drug release profile of Combination of HPMC K 15M+HPMC K 100M+Xanthum Gum

SUMMARY AND CONCLUSION

The combination polymer formulation (F13) showed the highest drug release (95%), indicating a synergistic effect of HPMC and Xanthan Gum in sustaining and controlling drug release.

Individual polymers demonstrated release between 79–89%, with HPMC K15M (F6) showing slightly higher release than HPMC K100M (F2) and Xanthan Gum (F12). % Drug Release of combined polymers Highest release (95%) observed in combined polymer formulation (F13), suggesting synergistic effect of HPMC + Xanthan Gum in controlling drug release.Individual polymers show release between 79–89%. Zero-Order Kinetics (R^2): F12 (Xanthan) shows the best fit for zero-order ($R^2 = 0.9864$), indicating nearly constant release rate.First-Order Kinetics (R^2): F2 (HPMC K100M) shows higher correlation with first-order. ($R^2 = 0.9905$), suggesting release rate depends on remaining drug concentration.Higuchi Model: All formulations show good fit, especially F2 ($R^2 = 0.9927$), indicating diffusion-controlled release Korsmeyer–Peppas Model: R^2 values >0.93 for all, suggesting anomalous (non-Fickian) transport, meaning release is controlled by both diffusion and polymer relaxation/swelling.

Conclusion: Combined polymer formulation (F13) provides the highest drug release with controlled kinetics. Polymer selection and combination influence both release rate and mechanism.

In conclusion, swelling polymers like xanthan gum, HPMC K15M, and HPMC K100M have proven effective in formulating controlled-release floating tablets of Raltegravir. The tablets were successfully

prepared without requiring a gas-generating agent. A combination of these polymers produced favorable results, with formulation F13 showing the highest effectiveness. This study offers valuable insights into the formulation and characterization of a controlled drug delivery system for Raltegravir Potassium using these hydrophilic polymers.F13 contains both HPMC (K15M or K100M) and Xanthan Gum, combining the properties of two hydrophilic polymers. HPMC forms a viscous gel layer upon hydration, controlling the release by diffusion through the gel. Xanthan Gum swells rapidly and creates microchannels in the matrix, facilitating water penetration and drug diffusion.The combination balances matrix integrity and porosity, allowing controlled but enhanced drug release compared to individual polymer. Single polymers may either gel too densely (HPMC K100M) → slower release, or swell too fast (Xanthan) → initial burst but shorter sustained release. In F13, moderate viscosity HPMC + highly swellable Xanthan forms a porous but cohesive gel layer. This ensures: Sustained floating behaviour Uniform water penetration Efficient drug diffusion.Diffusion and Non-Fickian Transport Kinetic analysis (Peppas model, R^2 = 0.9788) shows anomalous transport, meaning release is controlled by both diffusion through the gel and polymer relaxation/swelling. The combination polymer matrix optimizes both mechanisms, leading to higher cumulative release (95%) while maintaining controlled kinetics. Summary HPMC alone: Strong gel → slower diffusion → lower release. Xanthan alone: Fast swelling → some burst → moderate release. HPMC + Xanthan (F13): Balanced gel + swelling → enhanced water penetration and diffusion → highest sustained release.

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