Section A-Research Paper
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Formulation and Evaluation of Ramosetron Hydrochloride Sustained Release Matrix Tablet Using Different Ratios of Chitosan and *K*-Carrageenan Polymer

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ABSTRACT

Developing sustained-release matrix tablets of ramosetron HCl was the major goal of the current effort. A Ramosetron HCl formulation with a once-each-day sustained release is preferred to lower the frequency of administration and increase patient compliance. Such sustained release K-Carrageenan and Chitosan were chosen as the two distinct polymers used to develop the matrix tablet of Ramosetron HCl. After determining the appropriate ratio of the drug to the polymer to regulate drug release up to the specified time, the release rates were regulated by a single polymer and a combination of two polymers with varied rate-controlling capabilities. The IR investigation found no indication of a chemical interaction between the additives and the drug. The wet granulation process was used to obtain the granules. The angle of repose, % compressibility, and Hausner's ratio was examined as pre-compressional characteristics. These findings show that granules have good flowing properties. After considering physical characteristics such as weight variations, thickness, hardness, and friability of the tablet, the various formulations were examined for the percentage of drug content that had high consistency. The drug in-vitro release investigation was performed in phosphate buffer pH 7.4 for a period of 12 hours, and the outcome was within the acceptable range. The impact of polymer concentration was investigated. The percentage cumulative drug release method was used to assess the dissolution data. The performance of matrix tablets was evaluated for various polymer ratios. Drug dissolution experiments' results indicated enhanced drug release, polymer-induced polymer retardation, and increased performance potential. It was found that matrix tablets containing K-Carrageenan & Chitosan polymers effectively sustained the release of medication for up to twelve hours.

Keywords: Ramosetron HCl, *K*-Carrageenan, Chitosan, Matrix Tablet, Sustained Release.

1 INTRODUCTION

In the past, oral drug administration was the main method of drug delivery. Patient compliance is higher due to its easy administration, lack of sterility restrictions, and adaptable design of dose forms, the oral route has come out as one of the most popular methods of drug delivery [1]. Sustained release drug delivery aims primarily systems are to keep a steady drug level in the blood over a long period of time [2]. They are chemically inert, drug embedding capacity, and

drug release characteristics, matrix devices have steadily increased in the rationale for delaying a drug's release [3].

Biopolymers are synthetic materials made from natural resources. They can be chemically manufactured from biological material or biosynthesized from living things like algae [4].

One of the most common natural substances in nature is chitosan, a biological substance. It is a linear homopolysaccharide with a high molecular weight that is kept together by β-(1-4) linkages and is made up of repeated units of N-acetyl-D-glucosamine residues. Because chitosan has a positive ionic charge, it may attach to materials that have a negative charge, such as proteins, lipids, ions, negatively charged fat, and lipids. In addition, chitosan is non-toxic and possesses superior bioavailability, biodegradability, and adsorption qualities [5]. Early in the nineteenth century, Carrageenan (CG) use was first documented in Ireland. In Ireland, the word "Carrigan or carrageen" is frequently used and means "little rock". The term "CG" refers to a class of aqueous high-molecular-weight polysaccharides made up of alternative units of D-galactose & 3,6-anhydrogalactose (3,6-AG) linked by alternating α-1,3 & β-1,4- glycosidic linkages. Each repeating disaccharide unit in kappa, iota, and lambda-CG has one, two, or three ester-sulfate groups, respectively [5].

Ramosetron Hydrochloride is a white, amorphous powder that is soluble in alcohol and an aqueous medium. Antagonizing 5-HT_3 receptors is the function of ramosetron. By inhibiting serotonin from directly binding with 5-HT_3 receptors found in the sensory vagal nerve terminals of the gastrointestinal mucosa, it exerts its antiemetic properties. Ramosetron hydrochloride is a newly developed selective 5-hydroxytryptamine type 3 (5-HT3) receptors blocker that in comparison to existing 5-HT_3 receptor antagonists, apparently has more strong antiemetic effects. [6].

1.1 Release Kinetics

The first-order equation illustrates the release through systems where the rate of release is based on concentration [7]. Zero order describes the ongoing process, of concentration-independent drug release from the drug delivery system [8]. Higuchi's model describes the release of the drug via a matrix system, Higuchi gave the first example of a mathematical concept in 1963. This model may be used to analyze the release of medications integrated into solid & semi-solid matrices that are aqueous soluble and have limited solubility [9]. To examine the Fickian & non-Fickian drug discharge from swelling as well as nonswelling polymeric delivery systems, Ritger, Peppas, and Korsmeyer and Peppas devised an empirical equation [8].

2 MATERIALS

Chitosan was bought from Aura Biotechnologies Pvt. Ltd. in Chennai; Ramosetron Hydrochloride was bought from Yarrow Chem., Ghatkopar, Mumbai; K-Carrageenan was bought by Kantilal Brothers, Mulund West, Mumbai; Lactose, Magnesium Stearate, Talc, and Methyl Paraben were bought from Qualigens Fine Chemicals, Mumbai, India.

3 METHODS

3.1 Preformulation Studies

3.1.1 Determination of Melting Point

The melting point of the drug was established through the capillary fusion technique and the melting point apparatus. The melting point that was attained was noted and its value was compared to that found in the literature [10].

3.1.2 UV Spectrophotometric Studies

Ramosetron Hydrochloride (0.1%) stock solution is freshly produced by placing precisely weighed 100 mg of the drug into a 100 mg volumetric flask, dissolving it in triple-distilled water, and adjusting the volume to the desired concentration. Then, 25 ml, 20 ml, and 10 ml of the stock solution are transferred into three 100 ml standard flasks, respectively, and made up to the appropriate concentrations. These working standard solutions are 250 µg/ml, 200 µg/ml, and 100 µg/ml [11].

3.1.3 Determination of Bulk Density

Tapping on a granular cylinder mechanism with a specific cut rotating cam was used to determine the volume of powder packing. With the use of a funnel, a precisely weighed 50 grams of powder was put into the cylinder. The starting volume of powder was measured, and the sample was then subjected to 750 tappings, or until no further volume decline was noticed or the percentage of volume variation was less than 2%. To ensure repeatability for the substance in the equation, enough taps were used. Particle size distribution chance or attrition of particles of the substance under test was not caused by the tapping [12].

3.1.4 Determination of Tapped Density

Using tapped density apparatus, a bulk of additives and complexes was poured into a 250 ml graduated measuring cylinders. The graduated cylinder was exposed to 100 tappings until the volume change reached a constant value. 3 times the process was done, and as a consequence, the results of the tapped volume were determined by taking the mean of the values shown as final volumes [13].

3.1.5 Compressibility Index

The easiest approach to quantifying a powder's ability to flow freely is by measuring its

compressibility, which is determined by the material's % compressibility index (% CI) [12].

3.1.6 Hausner's Ratio

The Hausner ratio, which measures how easily powder flows and is linked to inter particulate friction, may be used to forecast some aspects of powder flow [13].

3.1.7 Determination of Angle of Repose

The angle of repose is the greatest angle that could be established between both the surfaces of the horizontal plane and the powder pile. This was established by pouring the necessary amounts of drug granules via a funnel onto a flat surface from a certain height (2 cm) until a heap developed that contacted the funnel's tip. The heap's height and radius were measured [14].

3.1.8 Drug Excipient Compatibility Study by FTIR

In disciplined to rule out any interaction effects between drugs and excipients, The Infrared spectra of physical combinations and the pure drug were contrasted [15].

3.1.9 Drug Solubility Study

3.1.9.1 Aqueous Solvent

The saturation shake flask method was used to calculate Ramosetron hydrochloride's solubility in water. A suitable concentration of Ramosetron hydrochloride was dissolved in distilled water with an acetate-buffer pH of 5.5, and after that, the slurry was centrifuged over 48 hrs at 37°C. The result was filtered before being subjected to a 370 nm spectrophotometric analysis. The measurement was taken in triplicate [16].

3.1.9.2 Organic Solvent

The saturation shake flask method was used to calculate Ramosetron hydrochloride's solubility in ethanol. A suitable concentration of Ramosetron hydrochloride was dissolved in ethanol and centrifuged the mixture at 37°C and 50 rpm for 48 hours. The obtained slurry was filtered and examined spectrophotometrically at 370 nm. The measurement was performed three times [17].

3.2 Using Wet Granulation Method For Tablet Preparation

Wet granulation was used to produce various tablet compositions. The 60# mesh sieve was used to filter all of the particles. The necessary amounts of the medication and compound were thoroughly mixed and an adequate amount of the binding agent was gently mixed. The bulk was sieved through 44 # mesh once an appropriate level of cohesion had been attained. For 12 hours, the granules were dried. At the moment of mixing, avicel is added as a lubricant. In addition to compressing the tablets using a single punch tablet compression machine, the actual weight of tablets was estimated depending based on drug contents granulation. Along with other components, each tablet has 10 mcg of ramosetron hydrochloride [18].

3.3 Evaluation of Tablet

3.3.1 Description

From each formulation, five tablets were chosen at random and their size, shape, and color were checked [19].

3.3.2 Hardness

Six tablets were chosen at random from every batch to be tested for hardness using a hardness analyzer Model VHT-1 (HICON, Grover Enterprises, Delhi, India). Hardness in kg/cm^2 was determined from the average of three measurements [20].

3.3.3 Thickness

20 tablets were ambiguously selected from every batch, & vernier calliper was used to assess every tablet's thickness [21].

3.3.4 Weight variation

20 tablets were irregularly selected from every formulation & weighed separately before the average weight of tablets was calculated and the difference between the individual weights and the average weight was determined [22].

3.3.5 Friability

Using Roche's Friabilator, 10 tablets were randomly chosen from each batch and precisely weighted. The tablets were kept in a plastic container that rotates at a speed of 25 revolutions per minute, falling a tablet every revolution from a distance of 6 inches. The tablets were then de-dusted and reweighted once the friabilator had completed 100 rotations [23].

3.3.6 Drug Content Uniformity

To extract the 10 mcg of medication from six crushed and powdered tablets, A pH 6.8 phosphate-buffered volume of 100 ml was used. The appropriate dilution of the solution was used for the spectrophotometric analysis of the drug concentration at a wavelength of 270 nm. Each sample underwent a triple analysis [24].

3.3.7 Disintegration Time

Utilizing a USP disintegrating apparatus with double-distilled water in 900 ml (pH 5.8), kept at 37°C ± 0.5°C, the disintegration time of the formulated sustained release tablets was measured[19]. Every piece of the broken tablet that went through the basket's screen was timed as it did so. As an estimate of in-vitro disintegration time, the mean of 3 measurements was recorded & expressed in minutes [14].

3.3.8 *In-Vitro* Drug Release

The in-vitro dissolution equipment, which revolved at a speed of 100 rpm, was accomplished

using the USP 24 disso. apparatus type II (Paddle technique). The dissolution test was performed over a complete 12-hour period, with the dissolution medium being 0.1 N HCl (pH 1.2) solution (750 ml) for the first 2 hours at 37 ± 0.5°C, and phosphate buffer solution pH 6.8 (1000 ml) for the next 8 hours. The dissolution media was prepared recently and pre-warmed to 37 ± 0.5°C. Every 10 ml of the sample was removed and restored with an equivalent volume at regular intervals [25]. When the samples were drawn and filtered using a 0.45µ membrane filter, the amount of drugs in every sample was determined using a U.V. method (270 nm). Ramosetron hydrochloride was used to prepare a standardization curve that was used to determine the samples' actual contents [26].

4 RESULT

4.1 Description

All of the formulations (SR1, SR2, SR3, SR4, SR5 & SR6) were found to be round and off-white.

4.2 UV Spectrophotometric Study

Ramosetron HCl stock solution (0.1%) is freshly produced by adding methanol to a 100 ml volumetric flask containing 100 mg of Ramosetron HCl that has been precisely weighed. The stock solution is then divided into three 100 ml standard flasks with a volume of 25.0, 20.0, and 10.0 ml each. These volumes are then made up to the required concentrations to make working standard solutions with a concentration of 250 µg/ml, 200 µg/ml, and 100 µg/ml.

4.3 Melting Point Determination

Ramosetron hydrochloride's melting point was determined to be 244 ± 0.15° C, which is close to the reference value, using melting point equipment made by Amtech India.

Table 4.1: Identification tests for drugs

S. No.	Parameters	Experimental Values	Literature Value
1	Melting point	244±0.15°C	244-246°C (I.P. 2009)
2	UV Spectrophotometric Studies in Methanol	271±0.22 nm	270 nm (I.P. 2007)

n=3

Values are expressed in Mean± SD

4..4 FTIR Drug Excipient Compatibility Study

The FTIR spectrum was used to examine the compatibility of ramosetron hydrochloride (API) with drug excipients, Peaks in the drug spectrum are correlated with peaks in the spectra of physical mixtures. This shows that the drug and the ingredient in the formulation are compatible. The graph is shown below.

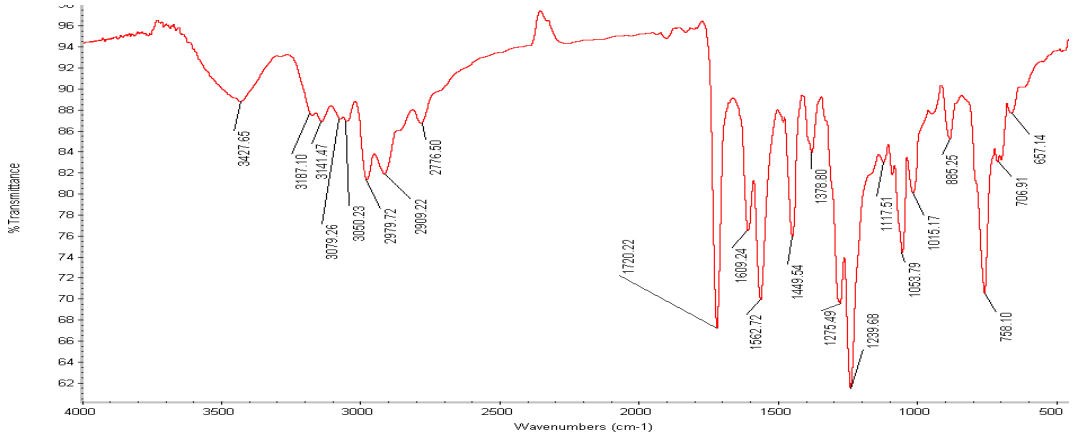

Fig 4.1 FT-IR representation of Ramosetron HCL (API)

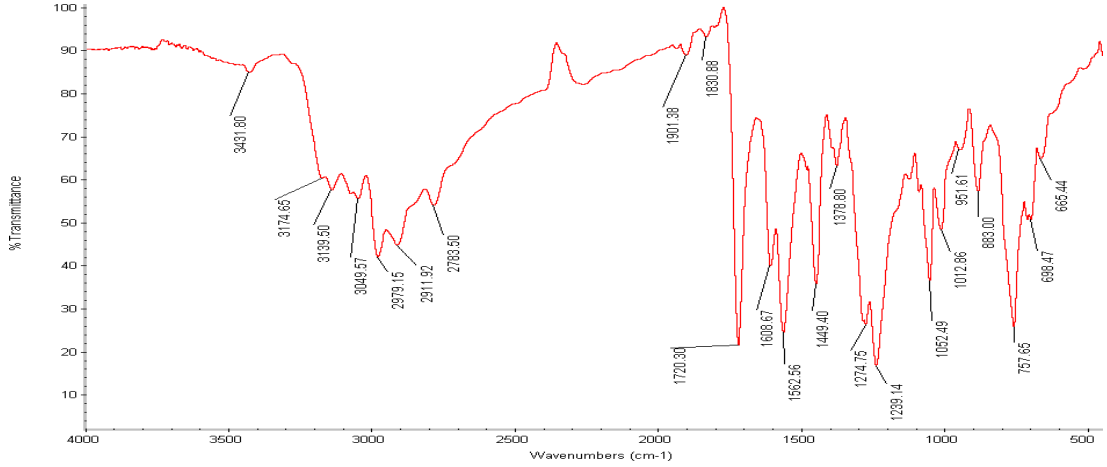

Fig 4.2 (a) FT-IR representation Ramosetron HCL+ *K*- Carrageenan

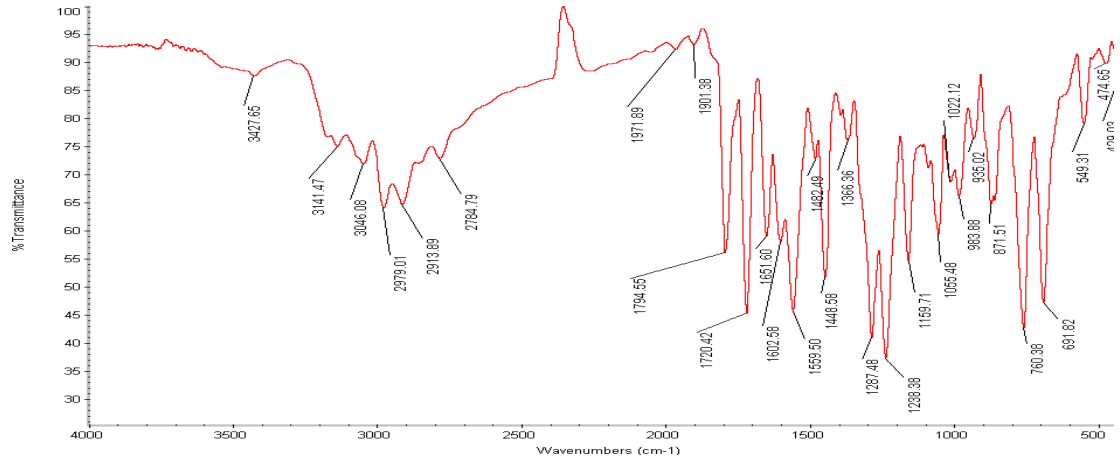

Fig 4.3 (b) FT-IR representation Ramosetron HCL+Chitosan

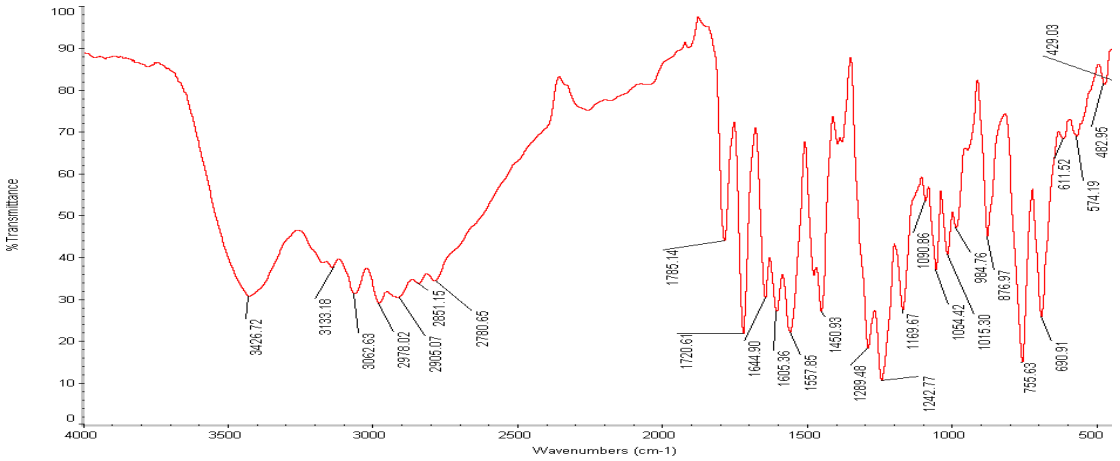

Fig 4.4 (c) FT-IR representation Ramosetron HCL+Lactose

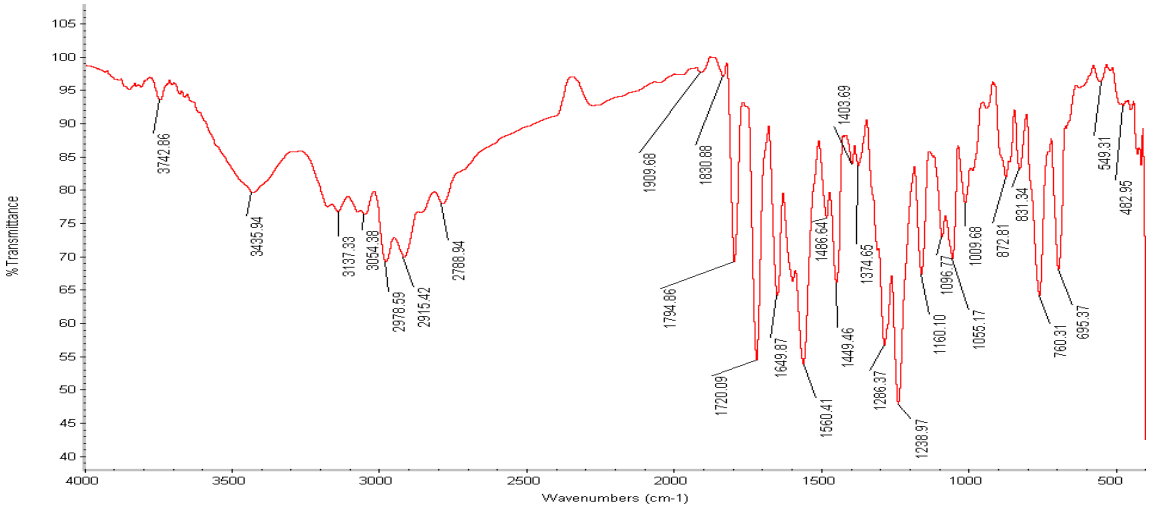

Fig 4.5 (d) FT-IR representation Ramosetron HCL+Methyl Paraben

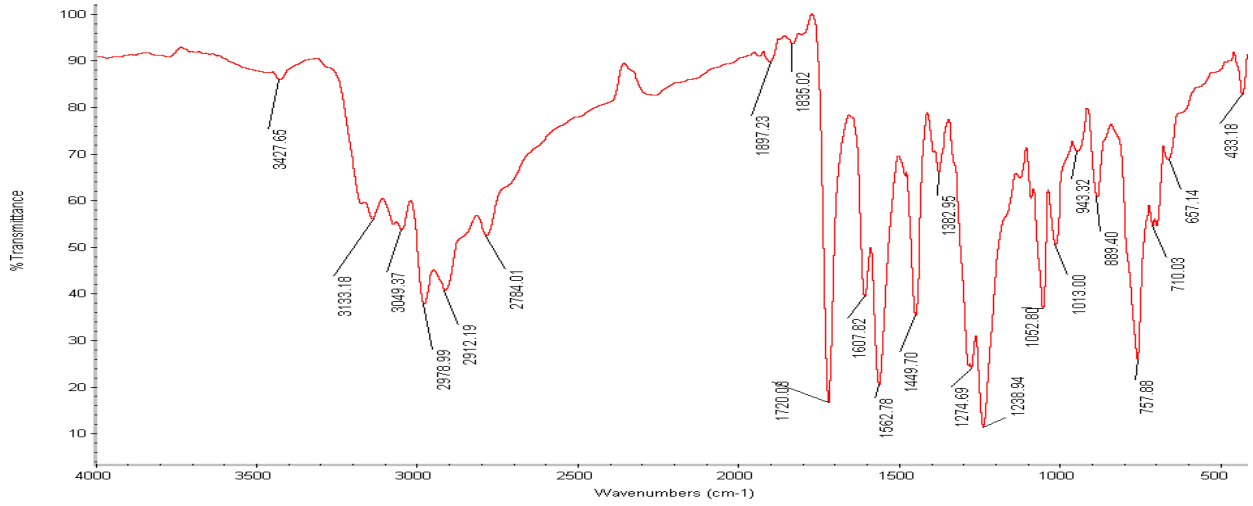

Fig 4.6 (e) FT-IR representation Ramosetron HCL+Talc

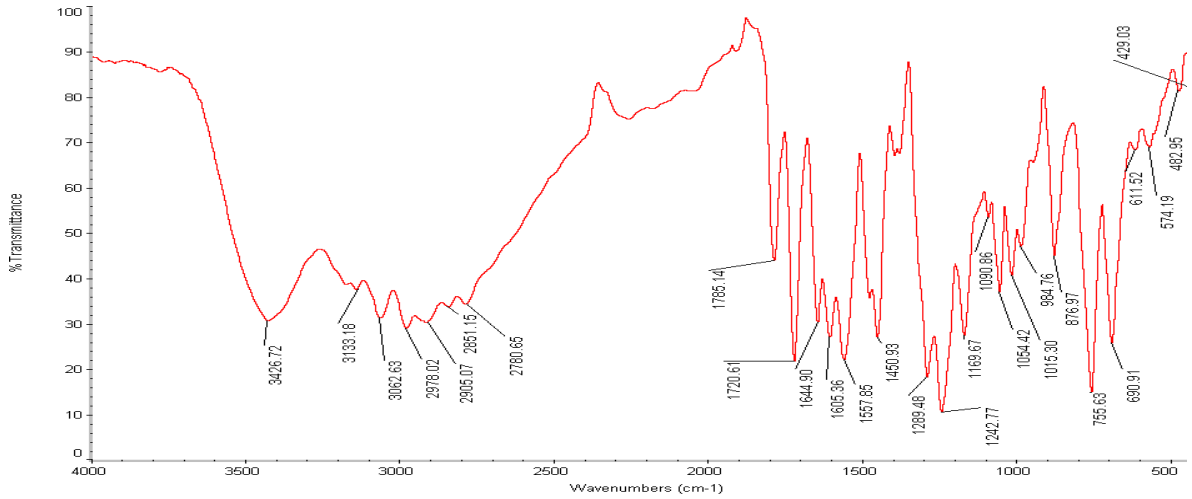

Fig 4.7 (f) FT-IR representation Ramosetron HCL+MCC

4.5 Drug Solubility Study

4.5.1 Aqueous Solvent

The water solubility test of Ramosetron hydrochloride was performed through the saturation shake flask method and found 62.00 mg/ml drug dissolve in water. It means the drug is soluble in aqueous medium.

4.5.2 Organic Solvent

The solubility of Ramosetron hydrochloride in ethanol was performed through the saturation shake flask method and the value is found to be 1.500 mg/ml drug dissolved in ethanol. It means the drug is slightly soluble in an organic solvent.

4.6 Formulation of Tablet by Wet Granulation Method

Table 4.2: Composition of Ramosetron Hydrochloride Tablets

Ingredients	SR1 (mg)	SR2 (mg)	SR3 (mg)	SR4 (mg)	SR5 (mg)
Ramosetron HCL	0.010	0.010	0.010	0.010	0.010
K- Carrageenan	100.00	50	-	75	25
Chitosan	-	50	100.0	25	75
Lactose Monohydrate	229.95	229.95	229.95	229.95	229.95
Methyl Paraben	0.04	0.04	0.04	0.04	0.04
Talc	40	40	40	40	40
MCC (Avicel)	30	30	30	30	30
Purified Water	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.

4.7 Evaluation of Tablet

This was done in the following manner:

- Pre-compression parameters
- Post compression parameters

4.7.1 Pre-compression parameters

4.7.1.1Angle of Repose

The angle of repose for each formulation was calculated using the fixed funnel method, and the results showed values ranging from 34.79±0.16 to 35.87±0.09, indicating that the granules had adequate flow characteristics for compression.

Table 4.3: Angle of Repose of the Formulation

Formulation	SR1	SR2	SR3	SR4	SR5
Angle of Repose	35.75±0.21	34.79±0.16	35.25±0.28	35.87±0.09	34.90±0.14
Flow	Fair	Good	Good	Fair	Good

n=3

Values are expressed in Mean± SD

4.7.1.2 Bulk Density

All of the compositions' bulk densities ranged between 0.460±0.18 g/ml to 0.469±0.13 g/ml.

4.7.1.3 Tapped Density

All formulations had tapped densities that varied from 00.338±0.09 g/ml to 0.349±0.22 g/ml.

4.7.1.4 Compressibility Ratio and Hausner's Ratio

All formulations were found to have compressibility ratios & Hausner's ratios in the range of 24.10±0.36 to 24.34±0.18 and 1.33±0.05 to 1.37±0.11, respectively. The flow property of each formulation was found to be reasonable.

Table 4.4: Pre-Compression Parameters of the Formulations

Formulations	Bulk Density (g/ml)	Tapped Density (g/ml)	Carr's Index (%)	Hausner's Ratio
SR1	0.461±0.10	0.340±0.06	24.10±0.36	1.33±0.05
SR2	0.460±0.18	0.338±0.09	24.24±0.27	1.35±0.08
SR3	0.464±0.12	0.341±0.14	24.29±0.23	1.36±0.12
SR4	0.466±0.15	0.349±0.22	24.34±0.18	1.34±0.11
SR5	0.469±0.13	0.336±0.11	24.32±0.22	1.37±0.07

n=3

Values are expressed in Mean± SD

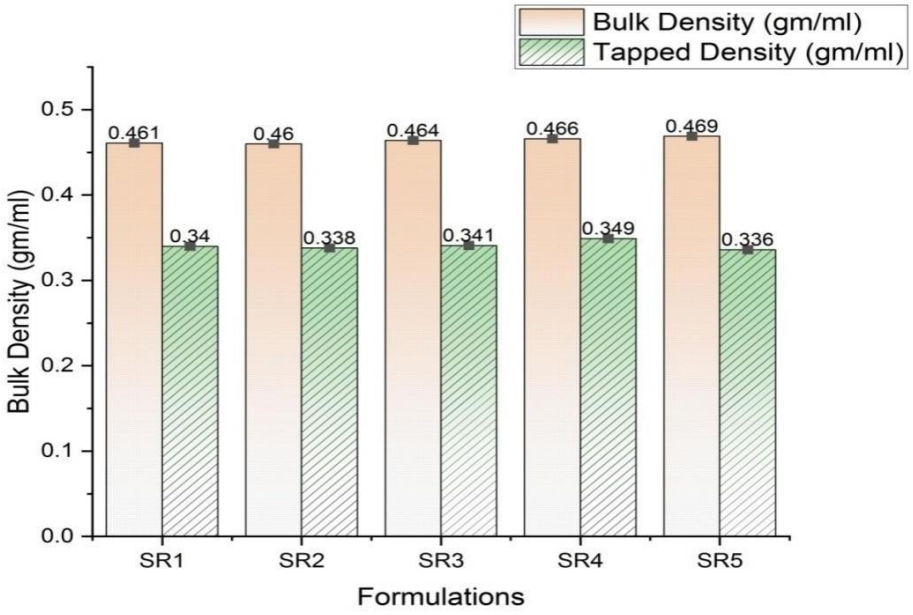

Fig 4.8: Precompression Parameter (Bulk & Tap Density)

4.7.1 Post-Compression Parameters

4.7.1.1 Determination of Hardness

The Monsanto apparatus was used to assess the hardness of all the developed formulations. All of the tablets' hardness was within the range of 5.01±0.15 kg/cm^2 to 7.68±0.33 kg/cm^2, demonstrating the formulations' strong ability to become mechanically stable throughout transit.

4.7.1.2 Weight Variation

Following the procedure outlined in the pharmacopeia (Indian Pharmacopoeia 1996), prepared

tablets were checked for weight variation. All of the formulations reportedly passed the weight variation test because the weight variation ranged from 402±0.36 to 411±0.40.

4.7.1.3 Thickness

Using Vernier Caliper equipment, the thickness of 10 tablets from different batches was tested, and the results were found to range between 3.91±0.21 to 4.06±0.11, as shown in the table below.

4.7.1.4 Friability

The earlier-discussed procedure was used to conduct the test for friability. According to the restrictions specified in Pharmacopoeia (Indian Pharmacopoeia 1996), the results were examined and categorized. The compendia specification for a tablet's mechanical characteristic called "friability" is not to exceed 1%. Friability is a surface deformation that may be improved to make it more friable. The claim was verified to be accurate for all the formulations that had been prepared and contained Avicel (MCC), and all of the values fell within the range of 0.19±0.11 to 0.29±0.18, which indicates that the formulations are mechanically stable.

4.7.1.5 Disintegration Time

All five formulations (SR1, SR2, SR3, SR4, and SR5) had disintegration times that ranged from 7.30±0.39 min to 8.65±0.16 minutes, which was within acceptable range.

4.7.1.6 Drug Content Uniformity

The uniformity of the content of Ramosetron hydrochloride tablets was assessed using UV-visible spectroscopy. The range of Ramosetron hydrochloride's drug content was between 83.82±0.28 to 95.63±0.15. The outcomes from the tablets' formulation were within acceptable limits.

Table 4.5: Comparative Findings of Different Evaluation Criteria for Prepared Tablets

Code	Weight variation	Hardness kg/cm^2	Thickness (mm)	Friability (%)	Disintegration time (min)	% Drug content
SR1	402±0.36	6.83±0.10	3.91±0.21	0.21±0.13	7.30±0.39	83.82±0.28
SR2	405±0.12	5.04±0.24	4.04±0.15	0.25±0.04	8.65±0.16	95.63±0.15
SR3	409±0.24	5.01±0.15	4.01±0.07	0.29±0.18	7.99±0.43	93.32±0.18
SR4	411±0.40	7.68±0.33	4.06±0.11	0.24±0.05	8.17±0.27	89.84±0.13
SR5	407±0.32	6.07±0.54	4.05±0.19	0.19±0.11	8.32±0.33	91.23±0.26

n=3

Values are expressed in Mean± SD

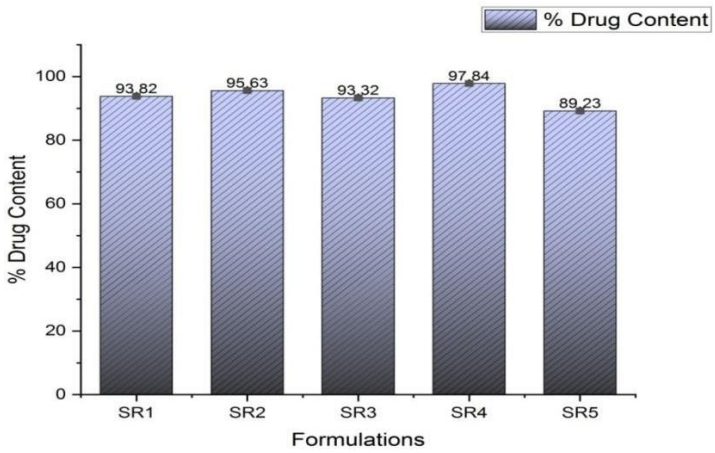

Fig 4.9: Drug Content of Ramosetron Hydrochloride Tablets

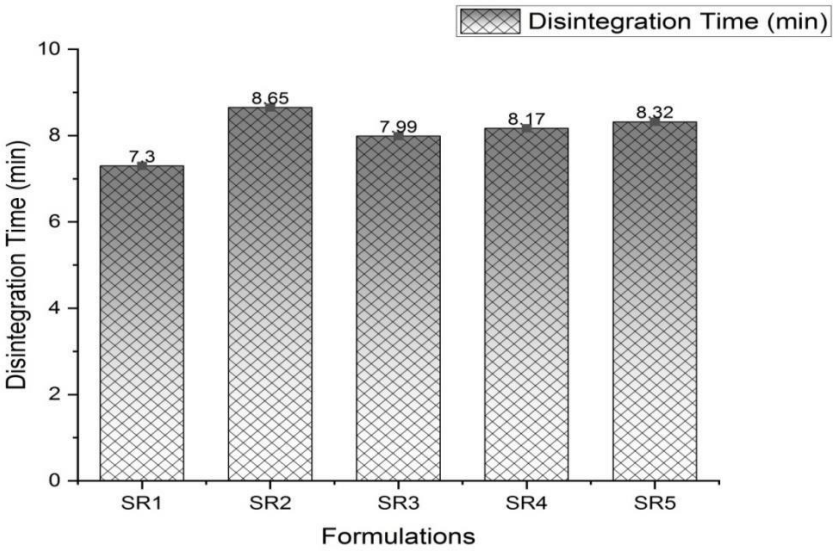

Fig 4.10: Disintegration Time of Ramosetron Hydrochloride Tablets

4.7.1.7 Quantitative Estimation of the Drug

4.7.1.7.1 Calibration Curve of Ramosetron Hydrochloride

Ramosetron Hydrochloride was examined using the UV Spectrophotometric method. Along with a wavelength of 270 nm, the drug's absorbance in phosphate-buffered pH 7.4 with a little amount of methanol was recorded. The standard curve for ramosetron hydrochloride in phosphate buffer solution pH 7.40 was linear from the origin to values between 2 and 10 g/ml. The curve illustrates Beer Lambert's law. The Ramosetron Hydrochloride standard calibration curve is shown in the following figure.

Table 4.6: Calibration Curve of Ramosetron Hydrochloride by using UV Spectroscopy

Name	Conc. (µg/ml)	Absorbance
Std. 1	0	0.150
Std. 2	2	0.285
Std. 3	4	0.461
Std. 4	6	0.588
Std. 5	8	0.748
Std. 6	10	0.897

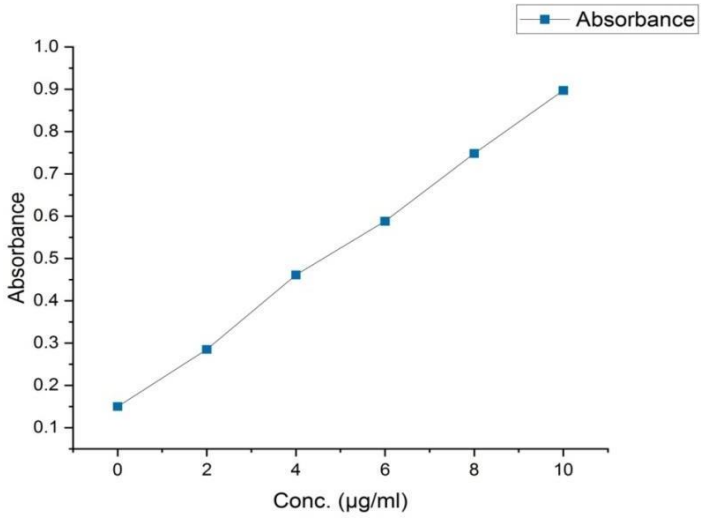

Figure 4.11: Calibration Curve of Ramosetron Hydrochloride

4.7.1.8 *In-vitro* drug release and kinetic profile

The in-vitro dissolution experiments were performed using the USP 24 disso. apparatus type II (Paddle Method), which revolved at a speed of 100 rpm. 0.1 N HCl (pH1.2) solution (750 ml) was used as the dissolving medium at 37±0.5^{o} C during the first two hours of the 12-hour dissolution test, and pH 6.80 PBS (1000 ml) was used for additional hours. At regular intervals, a sample of 10 ml was taken and restored with fresh dissolving media that had been pre-warmed to 37±0.5^{o}C. The samples were taken after being filtered using a 0.45-millimeter membrane filter, and each sample's drug content was then examined using a U.V. technique (270 nm). By using several kinetic models, such as the zero-order, first-order, Higuchi, and Korsemeyer-Peppas models, the in-vitro drug release profiles of the developed Ramosetrone hydrochloride-loaded matrix tablet formulation were statistically assessed. To clarify the mechanism of drug release profiling, the kinetics models were established statistically. The initialization and acceptance of kinetics commands were thought to benefit greatly from the high regression coefficient value.

Table 4.7: *In-vitro* drug release profile of different formulations

Time (hr)	% Drug Release± S.D.				
	SR1	**SR2**	**SR3**	**SR4**	**SR5**
1.	10.38±0.15	5.52±0.91	9.42±0.21	6.82±0.19	6.61±0.29
2.	14.32±0.73	11.47±0.16	15.58±0.52	10.82±0.73	9.40±0.59
3.	21.25±0.79	16.36±0.24	22.76±0.63	17.13±0.66	16.93±0.55
4.	32.75±0.26	27.15±0.96	31.62±0.49	24.25±0.89	25.56±0.18
5.	43.38±0.32	36.80±0.99	41.62±0.44	31.43±0.75	32.85±0.41
6.	52.14±0.15	44.64±0.96	50.83±0.82	40.72±0.56	39.73±0.65
7.	61.46±0.32	53.33±0.22	59.88±0.24	47.73±0.35	46.41±0.54
8.	70.65±0.67	59.86±0.58	68.58±0.33	55.72±0.65	54.24±0.44
9.	78.18±0.32	66.98±0.18	79.31±0.44	64.55±0.56	63.46±0.32
10.	85.54±0.39	71.55±0.62	84.74±0.58	72.61±0.40	70.64±0.49
11.	89.14±0.47	76.36±0.39	89.15±0.56	78.54±0.37	77.43±0.37
12.	93.56±0.61	78.23±0.74	94.04±0.33	83.78±0.81	85.33±0.27

n=3

Values are expressed in Mean± SD

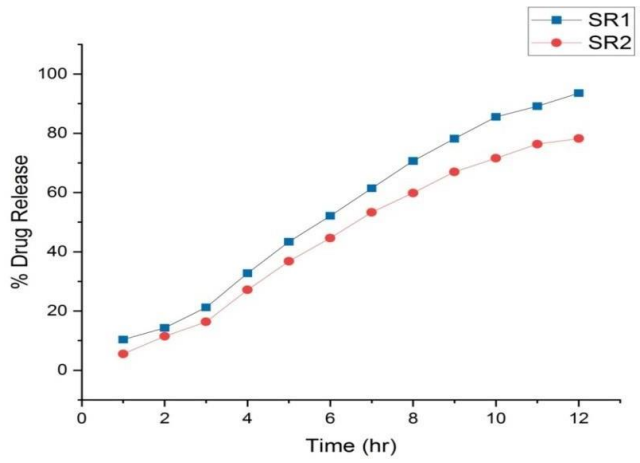

Figure 4.12: *In-Vitro* Drug Release of Ramosetron Hydrochloride SR1 & SR2

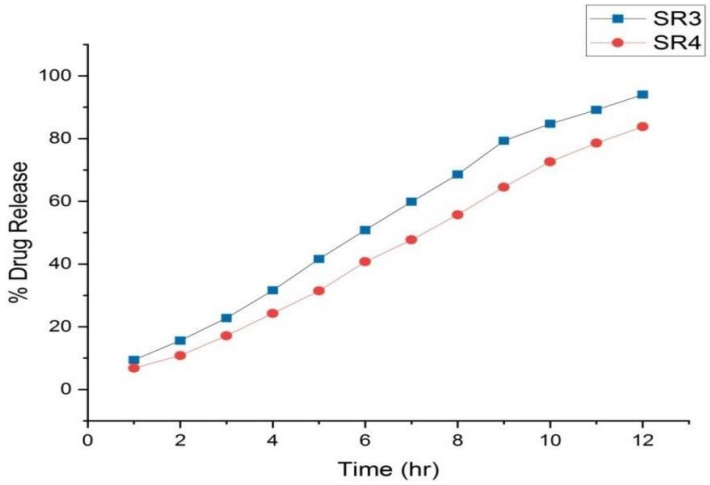

Figure 4.13: *In-Vitro* Drug Release of RamosetronHydrochloride SR3 & SR4

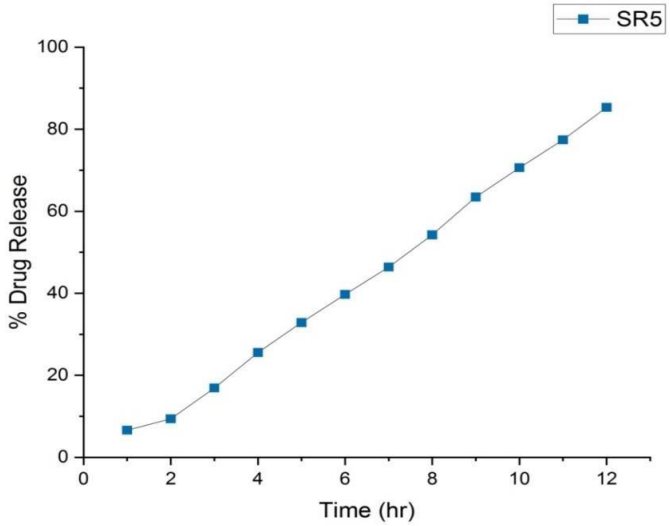

Figure 4.14: *In-Vitro* Drug Release of Ramosetron Hydrochloride SR5

5 DISCUSSION

For the granules of various formulations, loose bulk density, tapped density, and angle of repose were calculated. The loose bulk density and tapped density results varied between 0.460 ± 0.18 to 0.496 ± 0.13 and 0.338±0.09 to 0.349±0.22 subsequently. It was observed that angles of repose were between 34.79±0.16 to 35.87±0.09. The tablets had thicknesses between 3.91±0.21 to 4.06±0.11 mm. In all batches, the tablets' hardness and % friability varied from 5.01±0.15 to 7.68±0.334 kg/cm^2 and 0.19±0.11 to 0.29±0.18 subsequently. Within entirely distinct batches of the tablets, drug content was observed to be constant and varied from 83.82±0.28 to 95.63.5±0.15. Regarding thickness, hardness, drug content, and friability every batch of prepared

tablets was of excellent quality. The pharmacopeial requirements for weight fluctuation and friability were attained by all of the tablets. The drug-polymer ratio was shown to increase with a lowering in drug release from tablets. The release characteristics of the drugs Polymer K-Carrageenan and Chitosan in SR1 and SR3 (93.56±0.61 & 94.04±0.33) were good. Drug release was affected by both the drug-polymer ratio and the matrix's composition. Ramosetron hydrochloride sustained-release tablets have been developed using k-carrageenan and chitosan from hydrophilic matrix drug delivery systems. Chitosan is a pH-dependent polymer, whereas K-solubility carrageenans are pH-independent. Both types of polymer were utilized, and when they come into contact with an aqueous medium, they formed a strong, concentrated gel that might improve the sustained delivery of a water-soluble medication. Utilizing a USP 24 dissolution apparatus type-II, the in vitro drug release properties were evaluated over 12 hours in simulated stomach and intestinal fluid. A sustained release formulation of ramosetron hydrochloride (SR1, SR2, SR3, SR4 & SR5) should provide a release of 93.56±0.61, 78.23±0.74, 94.04±0.33, 83.78± 0.81 & 85.33±0.27 in 12 h, based on theoretical sustained release profile. The theoretical release profile is crucial for evaluating formulation rates and determining if it is unharnessed.

6 CONCLUSION

Ramosetron hydrochloride's predicted sustained release requirement was nearly met by the release profile of the tablets that were developed. Formulations released were similarly comparable to the tested SR tablets that were available in the market. The results of stability tests conducted on every batch at 45^{o}C with 75% relative humidity for 30 days showed that the drug's composition and rate of dissolution did not change. The results of the current investigation allow us to estimate that Ramosetron hydrochloride was discharged continuously for 12 hours. The findings also make it clear that all formulations provide a better approach for the continuous release of ramosetron hydrochloride once daily.

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None

9 CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

10 ABBREVIATIONS

HCl	Hydrochloride
IR	Infrared spectroscopy
CG	Carrageenan
5-HT_3	5-Hydroxytryptamine Type 3
Pvt.	Private
Ltd.	Limited
CI	Compressibility Index
FTIR	Fourier-transform infrared spectroscopy
USP	United States Pharmacopeia
Disso.	Dissolution
U. V.	Ultraviolet-visible spectroscopy
I. P.	Indian pharmacopoeia
SD	Standard deviation
API	Active pharmaceutical ingredient
MCC	Microcrystalline cellulose
SR	Sustained release
Q. S.	Quantity sufficient
Std.	Standard
PBS	Phosphate buffered saline

11 ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

12 HUMAN AND ANIMAL RIGHTS

Not applicable.

13 CONSENT FOR PUBLICATION

Not applicable.

14 CODE AVAILABILITY

Not applicable.

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