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FORMULATION AND EVALUATION OF METOPROLOL TARTRATE GASTRORETENTIVE FLOATING TABLET USING *LANNEA COROMANDELICA* GUM (LANNEA GUM) AS NATURAL POLYMER

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ABSTRACT

The objective of this work was to formulate and evaluate floating tablets of metoprolol tartrate with natural polymer *Lannea coromandelica* gum (Lannea gum) in comparison with synthetic polymer HPMC K100M. Metoprolol tartrate is used for the treatment of hypertension, angina pectoris, and cardiac arrhythmia. Its biological half-life is 3-4 hours, and it has a narrow absorption window. Different gastroretentive floating tablets of metoprolol tartrate were prepared using concentrations of Lannea gum ranging from 40% to 70% of the total weight of the tablet. For comparison, metoprolol tartrate gastroretentive floating tablets were also prepared using the synthetic polymer HPMC K100M with 70% concentration. The selected batches (F6, F7, F8 and F9) were evaluated for weight variation, thickness, friability, floating lag time, *in vitro* buoyancy time, drug content, and *in vitro* drug release kinetics. Formulation with *L. coromandelica* gum had shown better results than HPMC K100M. Based on the optimization process,

F8 was selected, as it showed maximum drug release up to 12 hours, a buoyancy lag time of 3.1 minutes and the drug content was found to be 99.72%. Drug release from F8 followed first-order kinetics and the mechanism of release followed anomalous non-Fickian diffusion as the Peppas exponent value ‘n’ was in the range of 0.645 - 0.682 i.e. swelling followed by diffusion.

KEYWORDS: Metoprolol tartrate, Floating tablet, *Lannea coromandelica*, Lannea gum, HPMC K100M.

1. INTRODUCTION

Gastro-retentive systems are designed to swell and are retained in the stomach for several hours, enabling continuous release of the drug at a controlled rate. This leads to higher bioavailability, therapeutic efficacy, reduced administration intervals and thus improved patient compliance. Hence, these gastroretentive drug delivery systems (GRDDS) are advantageous for drugs absorbed mainly from the upper part of the gastrointestinal tract (GIT) because they have a narrow absorption window and are unstable in the medium of distal intestinal regions.[1] They are even beneficial in localized treatment of gastric disorders. Compounding drugs with narrow absorption windows in a GRDDS would enable an extended absorption phase of these drugs.[2] The retention of oral dose forms in the upper GIT causes a prolonged contact time of the drug with the GI mucosa. Among gastro-retentive approaches, floating dosage forms have been investigated by several studies.[3] These systems are formulated to have a bulk density lower than the density of gastric fluid; hence, the buoyancy time of the floating dosage form was prolonged without any effects on the rate of gastric emptying.[4] These systems have important advantages that include greater and prolonged therapeutic effect, reducing the frequency, improving management of gastric disorders and minimizing drug degradation or adverse effects in the lower intestinal tract. However, many limitations of the floating dosage forms were reported. They were not applicable for irritant drugs for the gastric mucosa and they were also not suitable for drugs that have either solubility or stability problems in gastric fluids. Floating drug delivery systems can be classified as non-effervescent systems or effervescent systems.[5] Non-effervescent floating drug delivery systems swell in gastric fluid and maintain a relative stability of shape and bulk density less than the density of the gastric fluid, which assists the floating process of these dosage forms.[6] However, effervescent floating drug delivery systems based on effervescent components will liberate carbon dioxide due to the acidity of

the gastric fluid. Liberated gas bubbles will be entrapped in the gel layer formed by hydrocolloids that produce an upward motion of the dosage form and maintain its buoyancy.[7] Metoprolol tartrate (MT) is a β_1-selective adrenergic blocking agent.[8] **(Fig. 1)**. When MT conventional tablets are administered with food rather than on an empty stomach, peak plasma concentrations are higher and the extent of absorption of the drug is increased.[9] The maintenance of a constant plasma level of a cardiovascular drug is important in ensuring the desired therapeutic response. Since the half-life of MT is ~3 to 4 hours, multiple doses are needed to maintain a constant plasma concentration for a good therapeutic response and improved patient compliance. It has also been reported that MT absorption in the duodenum and jejunum is directly proportional to the dose availability.[10] The absorption mainly takes place in the duodenum and jejunum besides short half-life makes it a good candidate for a gastroretentive floating system.

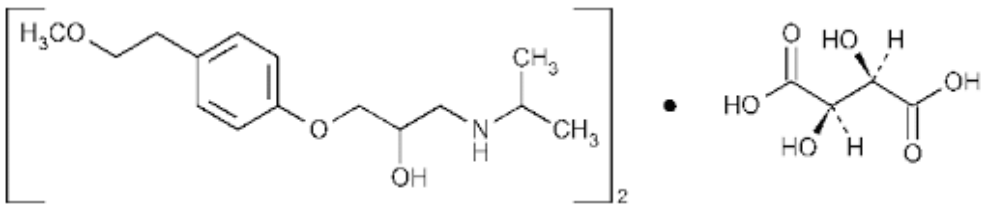


Fig. 1: Metoprolol Tartrate structure (USP28–NF23 Page: 1281).

The objective of the present investigation was to design a promising metoprolol tartrate effervescent floating sustained-release tablet by utilizing natural polymer *L. Coromandelica* gum, gel-forming polymers, sodium alginate, as well as an effervescent agent, sodium bicarbonate ($NaHCO_3$). The synthetic release-retarding polymer HPMC K100M was used to compare the optimized formula, including *Lannea* gum. The optimized formulation was designed to attain consistent 12-hour controlled-release tablets with good floating behavior and favorable physical tablet characteristics.

2. MATERIALS AND METHODS

Metoprolol tartrate is obtained as a gift sample from Emcure Pharma, Pune. *Lannea coromandelica* gum was purchased from Girijan Co-operative Corporation Ltd., Visakhapatnam. Sodium alginate from Motifs Labs, Goa, and sodium bicarbonate and magnesium stearate from SD Fine Chem Ltd., Mumbai. HPMC K100M was purchased from Unisule Pvt. Ltd., Haryana, Talc from Loba Chemie, Mumbai and hydrochloric acid from Qualinens Fine Chemicals Ltd., Mumbai.

2.1. Construction of calibration curve

Calibration curve for metoprolol tartrate was made by using an earlier reported method, measuring the wavelength at 222 nm.[11]

2.1.1. Preparation of metoprolol tartrate stock and standard solutions

100 mg of pure drug was transferred into 100 ml of 0.1N HCl in a volumetric flask, leading to. 1000µg/ml solution. From this solution, 10 ml was taken and diluted to 100 ml to obtain 100µg/ml (stock solution). The stock solution was further diluted using 0.1N HCl in a volumetric flask to obtain the standard solutions in the concentration of 5 – 30 µg/ml.

2.1.2. Maximum wavelength (λ_{max}) determination

A solution of metoprolol tartrate containing 30 µg/ ml was scanned in the range of 200-400 nm using a Lab India UV 3000 UV spectrophotometer. The λ_{max} obtained was 222 nm, which is similar to the reported value.

2.1.3. Calibration curve for metoprolol tartrate in 0.1N HCl (pH 1.2)

The absorbance of the prepared standard solutions in the concentration range of 5-30 µg/mL was measured at 222 nm. A calibration curve was plotted for absorbance versus concentration of metoprolol tartrate. The experiment was done in triplicate and average values are reported.

2.2. Preparation of metoprolol tartrate floating tablets

Metoprolol tartrate floating tablets containing 50 mg of the drug were prepared by the direct compression method according to the formulae as shown in (**Table 1)**. All the ingredients were initially passed through a mesh with a number 60 (aperture size 250 µm). Then all the ingredients were weighed and thoroughly mixed in a mortar using geometric dilution technique except talc and magnesium stearate. The amount of natural polymer *L. coromandelica* gum in these formulations varies from 40 and 70%. The amount of synthetic polymer HPMC K100M in F9 was 70% w/w. Finally, talc and magnesium stearate were added as lubricant and glidant for granules and mixed well in a polybag.

Table 1: Formulation of different batches (F1-F9) of Metoprolol tartrate floating tablets.

Ingredient (mg/tablet)	F1	F2	F3	F4	F5	F6	F7	F8	F9
Metoprolol tartrate	50	50	50	50	50	50	50	50	50
Lannea coromandelica gum	40	50	50	50	50	50	60	70	--
Sodium bicarbonate	10	10	10	20	20	30	30	40	40
Sodium alginate	--	--	10	20	40	50	50	60	60
HPMC K100M	--	--	--	--	--	--	--	--	70
Magnesium Stearate	7	7	7	7	7	7	7	7	7
Talc	8	8	8	8	8	8	8	8	8
Total weight (mg)	**115**	**125**	**135**	**155**	**175**	**195**	**205**	**235**	**235**

2.3. Micromeritic properties of powders blends for direct compression

2.3.1. Angle of repose

Angle of repose is the angle between the surface pile of granules and a horizontal plane. A fixed amount of blend was taken and carefully poured through the funnel whose tip was fixed at a height of 2.5 cm above graph paper, which was placed on a horizontal surface.[12] The blend of the powder was poured till the apex of the conical pile just touches the tip of the funnel. The angle of repose is calculated using the following formula.

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

Where, θ = angle of repose, r = radius of the pile, h = height of the pile.

2.3.2. Bulk density

Bulk density (BD) is defined as the ratio mass of an untapped powder divided by the bulk volume (V) including the inter-particulate void spaces. Apparent BD was determined by pouring the blend into a graduated cylinder.[13] The bulk V and weight of the powder (M) was determined. The BD was calculated using the following formula:

$$BD = M / V$$

2.3.3. Tapped density

A measuring cylinder containing a known mass of blend was tapped for a fixed time (around 100 taps). The minimum volume (Vt) occupied in the cylinder and the weight (M) of the blend was Measured.[14] The Tapped density (TD) was calculated using the following formula:

$$TD = M / (Vt)$$

2.3.4. Carr's index

The compressibility index (CI) is an indirect measure of bulk density, size, shape, surface area, moisture content, and cohesiveness of powder.[15] The correlation between compressibility index and powder flow properties is given in the following formula:

$$CI\ (\%) = TD - BD / TD \times 100$$

2.3.5. Hausner's ratio

This is an indirect index of ease of powder flow and is measured by the ratio of TD to BD.[16]

$$\text{Hausner's ratio} = TD / BD$$

2.4. Compression of tablets

The powder blends were compressed into tablets using on a 12-station rotary tablet machine (Karnavati Engineering Ltd., India) using compression force sufficient for obtaining hardness in the range of 4-5 kg/cm^2. 6 mm round flat punches were used for F1, F2 and F3 formulations and for the remaining formulations 9 mm round flat punches were used.

2.5. In vitro characterization of developed floating tablets

The prepared tablets were evaluated for thickness, weight variation, friability, hardness, drug content, *in vitro* buoyancy studies, floating lag time and *in vitro* drug release studies.[17]

2.5.1. Thickness

The thickness of tablet is measured by Vernier calipers. Tablet thickness should be controlled with in a ±5% variation of a standard value. In addition, thickness must be controlled to facilitate packaging.[18] The thickness in millimeters (mm) was measured individually for ten pre-weighed tablets. The average thickness and standard deviation were reported.

2.5.2. 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 determining the drug content uniformity.[19] The percent deviation was calculated using the following formula:

$$\%\ \text{Deviation} = (\text{Individual wt.} - \text{Average wt.} / \text{Average wt.}) \times 100$$

2.5.3. 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 conditions of storage, transportation and handling before usage depends on its hardness. It is expressed in kg/cm^2. For each formulation, the hardness of 10 tablets was determined using hardness tester and the average was calculated and presented with standard deviation.[20]

2.5.4. Friability

Friability of the tablets was determined using Roche Friabilator (Electrolab, India) that is set at 25 rpm for 4 minutes dropping the tablets at a distance of 6 inches with pre-weighed sample of 20 tablets.[21] Tablets were dusted using a soft muslin cloth and reweighed. The friability (F %) is given by the formula:

$$F\ \% = (1\text{-}W0 / W) \times 100$$

2.5.5. Determination of drug content

Ten tablets were taken, powdered and the powder equivalent to one dose each was transferred to a 100 mL volumetric flask and 0.1N HCl was added. The volume was then made up to the mark with 0.1N HCl. The solution was filtered and diluted suitably and Metoprolol tartrate content in the samples was estimated using UV - Visible spectrophotometer at λ_{max} of 223 nm. The experiment was performed in triplicate and average values are reported.[22]

2.5.6. In vitro buoyancy determination

The *in vitro* buoyancy was determined by floating lag time, as per the method described by Rosa *et al*. The tablets were placed in a beaker containing 100 mL of 0.1N HCl. The time required for the tablet to rise to the surface and float was determined as floating lag time. The duration of time for which the dosage form constantly remained on the surface of medium was determined as the total floating time.[23]

2.5.7. In vitro dissolution studies

The *in vitro* metoprolol tartrate release study was performed for the single unit tablets using USP Dissolution Apparatus II (Paddle type) (Lab India). The dissolution test was performed using 900 mL of 0.1N HCl at 37 ºC±0.5ºC. The speed of rotation of paddle was set at 50 rpm. 5 mL samples were withdrawn at different time points using the syringe fitted with 0.45 µm

filter. The same volume was replaced with 0.1N HCl maintained at 37 ºC±0.5ºC. Absorbance of sample was measured at 223 nm and drug released at different time points was determined by using calibration curve. The cumulative percent of drug released versus time was calculated and plotted as dissolution curve.[24]

2.5.8. In vitro drug release kinetics and mechanism

The kinetics of drug release from the tablets was studied by fitting the dissolution data to zero and first-order. The drug release mechanism was assessed by using Higuchi, Hixson-Crowell equations and further analyzed by Korsemeyer-Peppas equation.[25]

2.6. Drug-excipient compatibility studies

2.6.1. Fourier-transform infrared (FTIR)

The spectrum analysis of pure drug and physical mixture of drug and different excipients used for the preparation of tablets was studied using FTIR. FTIR spectra were recorded by preparing potassium bromide (KBr) discs using normally FTIR (Perkin Elmer). KBr discs were prepared by mixing a few milligrams of sample with KBr and compressed at 10 tons pressure. The resultant disc was mounted in a suitable holder in an IR spectrophotometer and the spectrum was recorded from 4000 cm^{-1} to 500 cm^{-1}. The resultant spectrum was compared for any spectral changes. They were observed for the presence of characteristic peaks for the respective functional group in the compound.[26]

2.6.2. Differential Scanning Calorimetry (DSC)

DSC scan of about 5mg of pure metoprolol tartrate and optimized formulation (F8) were accurately weighed then were performed by using an automatic thermal analyzer system. Sealed and perforated aluminum pans were used in the experiments for the samples. Temperature calibrations were performed using indium as standard. An empty pan sealed in the same way as for the sample was used as a reference. The entire samples were run at a scanning rate of 10°C/min from 50-300°C.

3. RESULTS AND DISCUSSION

3.1. Construction of calibration curve

The method reported by Horyn et al. (2022), workers was used for the estimation of metoprolol tartrate in the present work. The λ_{max} coincided with the reported value of 223 nm. The calibration curve constructed in 0.1N HCl obeyed Beer-Lambert law in the concentration

range of 5 - 30 µg/mL with coefficient of determination value near to 1 (R^2=0.9975) as shown in **(Fig. 2).**

3.2. Micromeritic properties of powder blends for direct compression

The micromeritic properties such as Carr's index, Hausner ratio, and angle of repose were determined and the results are shown in the **(Table 2)**. Carr's index of the granules ranged from 11.1 to 14.9 showing the powder blends are free flowing (C.I = 12-16 indicating good flow). Hausner ratio was found to be in the range of 1.00 to 1.16 (H.R. = 0-1.2 indicating free flowing property). The angle of repose of all the powder blends was found to be ≤30°, hence are free flowing. All the micromeritic properties of the powder blends indicated good flow characteristics and hence the tablets were prepared by direct compression.

3.3. Evaluation of tablet properties of metoprolol tartrate floating tablets

All the prepared formulations were tested for physical parameters like hardness, thickness, weight variation, friability and found to be within the pharmacopoeia's limits. The results of the tests are tabulated in (**Table 3**). The drug content of all the formulations was determined and was found to be within the permissible limit. This study indicated that all the prepared formulations were of acceptable quality norms.

3.4. Floating properties of metoprolol tartrate of gastroretentive floating tablets

All the formulations were tested for floating properties like floating lag time and total floating time. All the batches showed good *in vitro* buoyancy. The results of the *in vitro* buoyancy study are shown in **(Table 4).** In the present study, floating tablets of metoprolol tartrate were prepared by using different amounts of Lannea gum and HPMC K100M. In formulation F1 and F2 were prepared by adding Lannea gum to the drug powder, whereas formulations F3 to F8 were prepared by adding lannea gum powder to the drug granules prepared by using different quantities of sodium alginate as release controlling polymer and were compressed into tablets. Whereas in the formulation F9 the synthetic polymer HPMC K100M is used instead of lannea gum.

3.5. Drug-excipient compatibility studies

3.5.1. FTIR Spectroscopy studies

FTIR spectra of pure drug (metoprolol tartrate) showed characteristic peaks near 3464–2453 cm^{-1} (−NH2+, −OH aliphatic and aromatic –CH stretching), 1573 cm^{-1} (carboxylic acid salt), 1514 cm^{-1} (aromatic ring), 1247 cm^{-1} (isopropyl group) and 1114 cm−1 (aliphatic ether

secondary alcohol), 823 cm−1 (1,4-disubstituted benzene) **(Fig. 3)**. The above peaks were also observed for the granules prepared using different polymers like HPMC K100M and Lannea gum. Hence there is no interaction between metoprolol tartrate and polymers used in the present research work.

3.5.2. Differential Scanning Calorimeter (DSC) Studies

The DSC thermograms of pure metoprolol tartrate and physical mixture of drug and other excipient with lannea gum as polymer are given in **(Fig. 4)**. The metoprolol had shown the melting endotherm at 122.6°C. The value agreed with the literature value of 122.3°C, the fusion temperature of metoprolol tartrate. The polymer and the drug were closely maintained at same temperature throughout the analysis. The DSC thermogram of pure drug and polymer were recorded with reference as a function temperature. The DSC thermograms show well defined peak for drug in individual and combination with polymers indicates there is no significant interaction between the drug and polymers.

In the present work attempts have been made to formulate floating tablets of Metoprolol tartrate with Lannea gum and last formulation with HPMC K100M through direct compression method by taking single polymer in the formulation **(Fig. 5)**. Metoprolol tartrate has good absorption window since its absorption occurs in the duodenum and jejunum. Therefore, it was considered as a good candidate for gastroretentive dosage form. The development of gastroretentive floating drug delivery system of Metoprolol tartrate, to increase gastric residence time and thereby its therapeutic efficacy against hypertension in single unit floating matrix tablets with different natural and synthetic polymers meets all the ideal characteristics to formulate in the form of floating tablets. Based on the studies of the formulations, their physical properties such as bulk density and tapped density, angle of repose, Carr's index, Hausner ratio were within official standards. FT-IR and DSC studies showed no incompatibility between drug, polymer and various excipients used in the formulations **(Table 7)**. Formulated tablets gave satisfactory results for various evaluation parameters like tablet dimensions, hardness, weight variation, friability, content uniformity, in vitro buoyancy properties and in vitro drug release. Lannea gum along with sodium alginate as gelling agent (25%) in optimum concentration can be used to formulate controlled release GFDDS of metoprolol tartrate. The results of present study clearly indicated the GFDDS for metoprolol tartrate were successfully formulated by using hydrophilic polymers such as lannea gum HPMC K100M.

Plots of log fraction of metoprolol tartrate released versus log time of floating systems of F6, F7, F8, and F9 found to be linear as given in **(Table 5).** The r-values of these matrices are found to be 0.9658, 0.9687, 0.9713, and 0.9751 respectively. The n-values for the above formulations are found to be 0.682, 0.663, 0.645, and 0.649 respectively indicating that the release mechanism followed non-Fickian diffusion. Based on the above optimization process F8 was selected, as it showed maximum drug release up to 12 hours, buoyancy lag time of 3.1 minutes and the drug content was found to be 99.72 % **(Fig. 6; Table 6).** It follows first-order release and Hixson-Crowell model with anomalous non-Fickian transport i.e. swelling followed by diffusion.

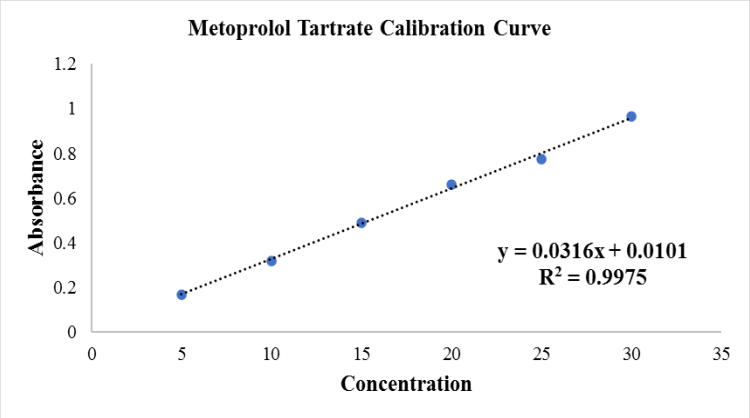


Fig. 2: Calibration curve of metoprolol tartrate in 0.1N.

Table 2: Micromeritic properties of the powder blends. (mean±s.d., n=3)

Formulation	% Carr's Index	Angle of repose (θ)	Hausner ratio
F1	13.5	29.4°	1.10
F2	12.3	29.3°	1.11
F3	13.4	29.5°	1.12
F4	12.1	29.4°	1.00
F5	12.3	29.3°	1.12
F6	12.2	29.4°	1.13
F7	13.6	28.4°	1.02
F8	12.5	26.9°	1.16
F9	14.9	27.5°	1.15

Table 3: Tablet properties of metoprolol tartrate floating tablets.

Formula code	Weight [a] (mg)	Hardness [a] (kg/cm^2)	Thickness (mm)	Friability [b] (%)	Drug content [c] (%)
F1	115.15±0.96	4.234±0.54	4.20±0.43	0.35	99.53
F2	125.26±0.88	4.122±0.23	4.94±0.55	0.43	98.87
F3	135.09±1.01	5.150±1.15	4.17±0.23	0.20	99.62
F4	155.12±1.48	5.112±0.34	3.24±0.30	0.18	98.48

F5	175.27±0.73	4.100±0.23	2.95±0.25	0.16	99.64
FT6	195.25±1.53	4.167±0.285	2.95±0.74	0.48	99.34
FT7	205.16±0.86	5.167±2.887	3.04±0.79	0.32	98.12
FT8	235.73±1.04	5.140±0.24	3.01±0.67	0.19	99.72
F9	235.34±1.23	5.200±0.23	2.96±0.27	0.25	98.45
a: Mean ±%deviation, n = 20; b: mean±s.d., n = 5; c: Mean ± s.d., n=3 s.d.= Standard deviation					

Table 4: *In vitro* buoyancy and total floating time of metoprolol tartrate floating tablets.

Formulation	Buoyancy lag time (sec)	Total floating time (hrs)
F1	36	2
F2	45	2.5
F3	52	3
F4	60	6
F5	76	9
F6	90	10
F7	114	10
F8	186	12
F9	175	12

Table 5: Cumulative percent of metoprolol Tartrate released from gastroretentive floating tablets.

Time (Hours)	Cumulative percent of metoprolol tartrate released (n=3, mean ± s.d.)			
	F6	F7	F8	F9
0.25	19.68	18.45	16.95	16.55
0.5	25.91	23.44	21.29	20.23
0.75	33.87	32.55	30.29	25.86
1	39.19	37.53	35.87	35.64
2	46.19	44.26	42.94	41.97
3	52.36	50.93	47.88	50.43
4	64.04	61.56	58.55	61.96
5	75.84	72.98	71.22	69.95
6	89.32	85.85	80.15	75.02
8	99.22	95.40	89.83	85.29
10		99.02	94.82	94.08
12			99.01	100.117

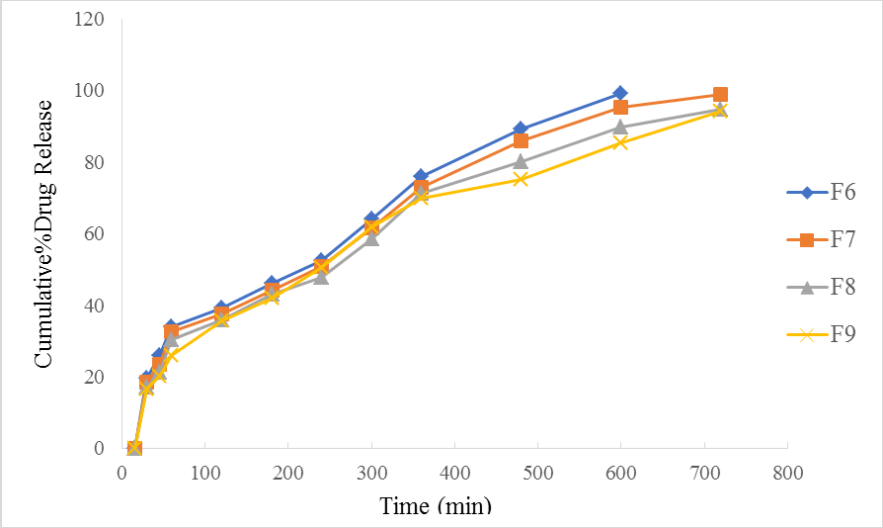
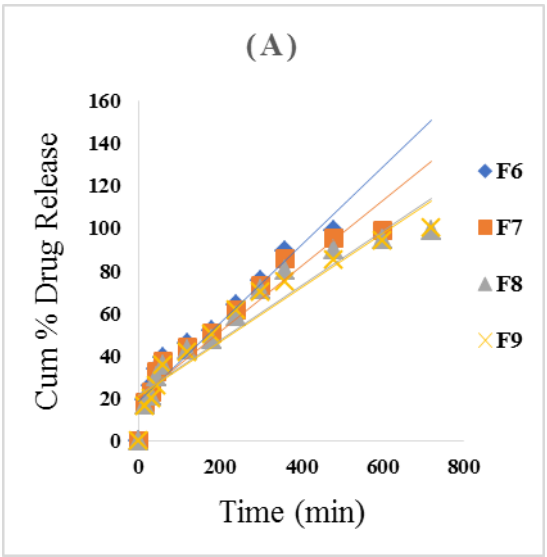
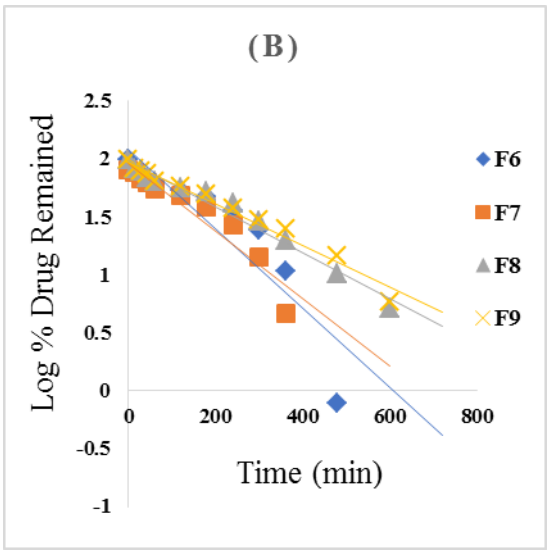


Fig. 4: Dissolution profile of gastroretentive floating tablets of metoprolol tartrate employed lannea gum and HPMC K100M.

Table 6: Correlation coefficients (r) of release kinetics of MT GFDDS tablets prepared from various concentrations of Lannea gum and HPMC K100M.

Formulation	Zero order Kinetic	First order Kinetic	Higuchi Model	Hixson-Crowell	Korsmeyer-Peppas	(n) value
F6	0.9666	0.9589	0.9916	0.9724	0.9658	0.682
F7	0.9579	0.9616	0.9918	0.9909	0.9687	0.663
F8	0.9494	0.9718	0.9936	0.9954	0.9713	0.645
F9	0.9539	0.9881	0.9976	0.9945	0.9751	0.649





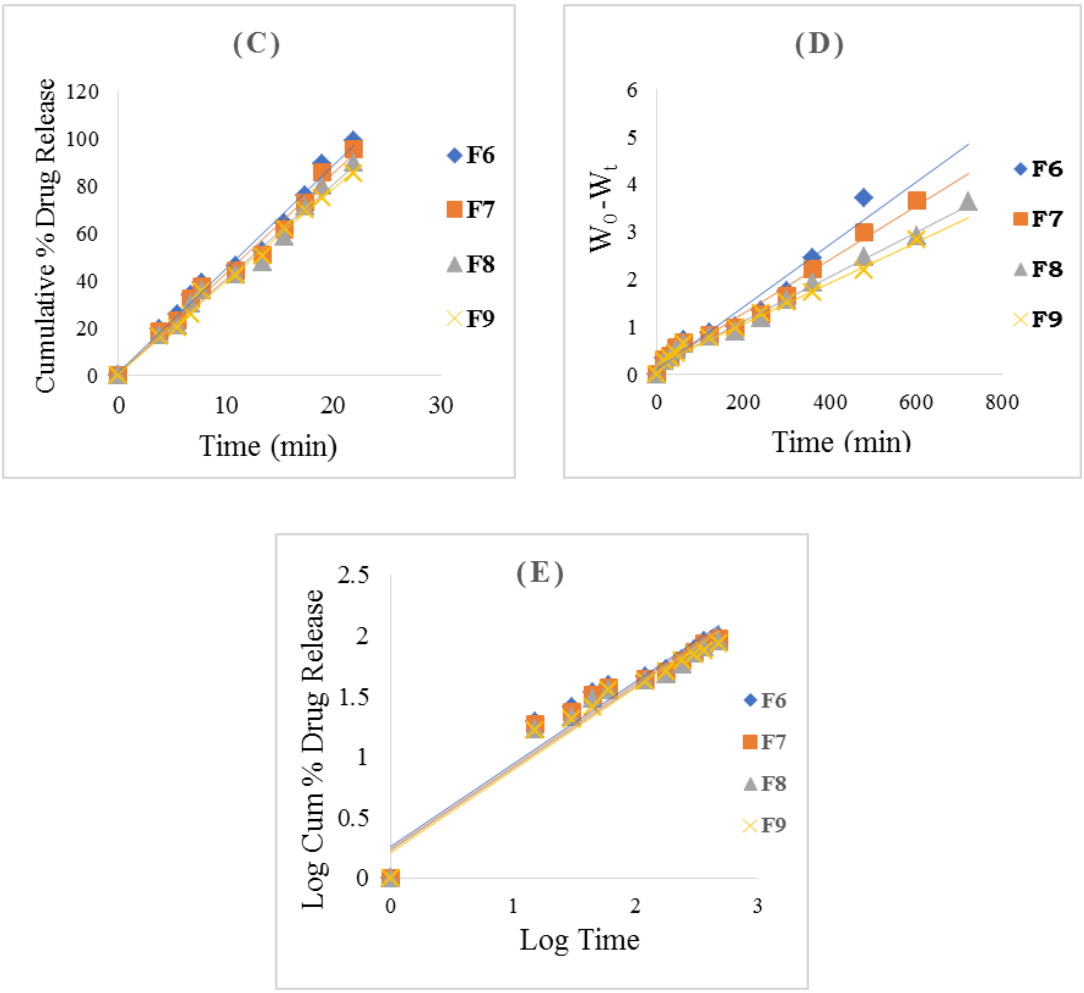
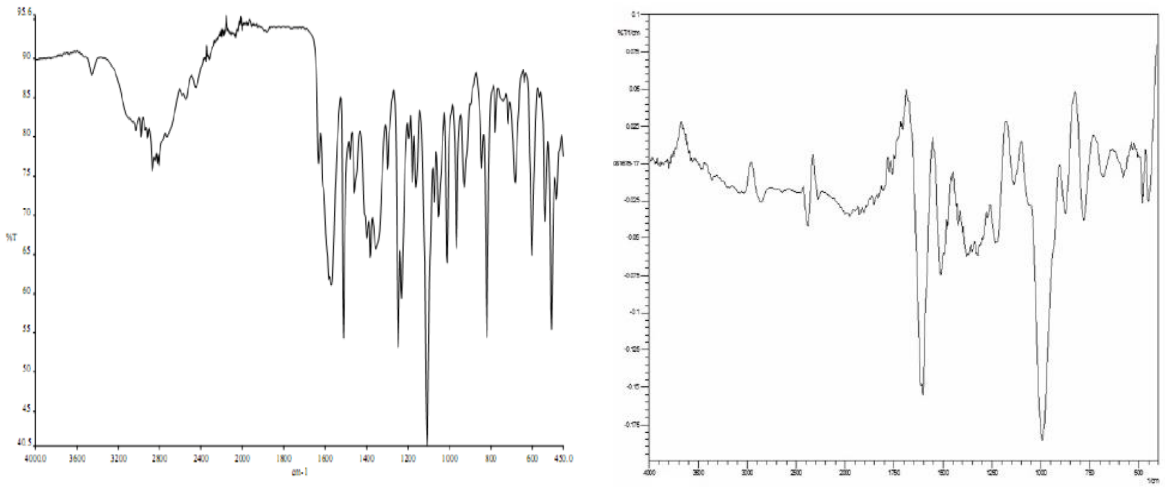
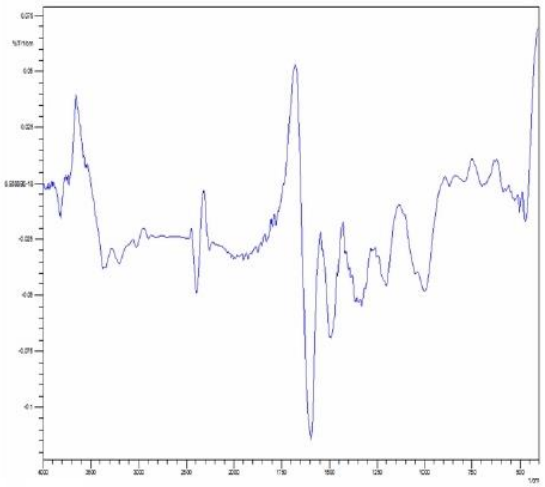


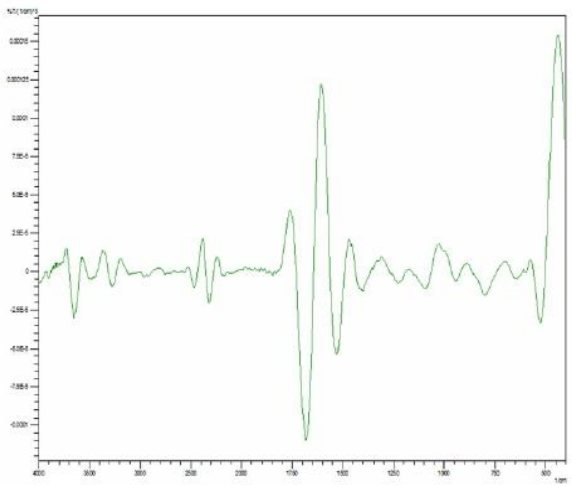
Fig. 5: Linear regression plots for the dissolution profile of metoprolol tartrate floating tablets with lannea gum in F6, F7, and F8 and with HPMC K100M in F9. (A) Zero-order release (B) First-order release (C) Higuchi model (D) Hixson-Crowell model (E) Korsmeyer-Peppas model.



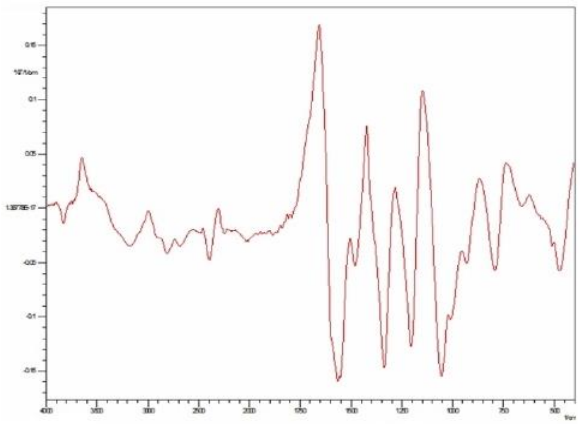
(a) **(b)**



(c)



(d)

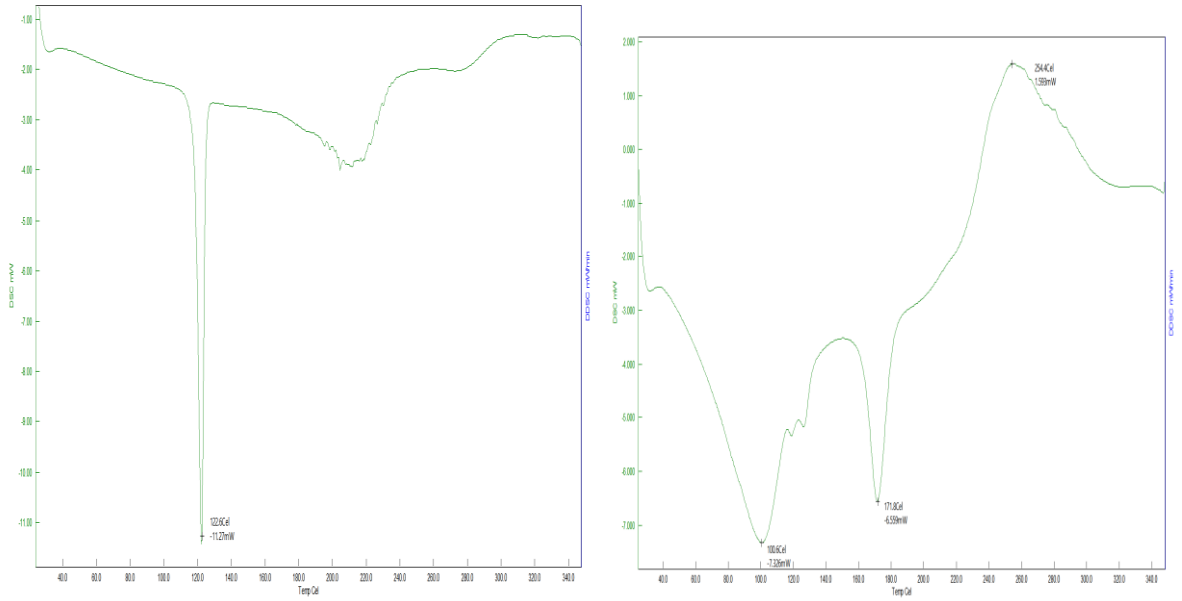


(e)

Fig. 3: FTIR Spectra of (a) Metoprolol tartrate (b) *Lannea coromandelica* gum (c) Physical mixture of Metoprolol tartrate and *L. coromandelica* gum (d) HPMC K100M (e) Physical mixture of Metoprolol tartrate and HPMC K100M.

Table 7: FTIR data interpretation.

Assignment of bands	Absorption range (cm^{-1})	Metoprolol Tartrate (cm^{-1})	Drug + Lannea gum. (cm^{-1})	Drug + HPMC K100M (cm^{-1})
-NH2, -OH aliphatic and aromatic –CH stretching	3500-2500	3464 - 2453	3460 - 2449	3466 - 2455
Carboxylic acid salt	1780-1710	1573	1573	1573
Aromatic ring	1600-1500	1514	1516	1514
Isopropyl group	1000-1350	1247	1246	1244
Aliphatic ether secondary alcohol	1085-1150	1112	1114	1114
1,4-disubstituted benzene	810-840	823	827	819



(a) **(b)**

Fig. 6: DSC thermogram of (a) Metoprolol tartrate (b) Physical mixture of F8 and *Lannea coromandelica* gum.

4. CONCLUSION

The present study shows that Metoprolol tartrate can be made into floating tablet dosage form by direct compression technique. Metoprolol tartrate prepared with Lannea gum and HPMC K100M exhibits very good tableting properties. The *in vitro* drug release profile was applied in different mathematical models and was interpreted in the form of graphical presentation and evaluated by correlation coefficient (r). The highest degree of correlation coefficient determines that the drug release from the system follow non-Fickian mechanism. Metoprolol tartrate floating tablets with Lannea gum and HPMC K100M by taking single polymer in the formulations in which F6, F7, F8 and F9 gave better controlled drug release and floating properties in comparison to the other formulations. From the above observations, we concluded that Metoprolol tartrate may reside in the stomach for a longer period of time when it is administered in the form of floating tablets in comparison with the conventional system

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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