Research Article **CODEX: IJRPJK** **ISSN: 2319 – 9563**

International Journal of Research in Pharmaceutical and Nano Sciences

Journal homepage: **www.ijrpns.com**

FORMULATION AND EVALUATION OF GASTRO RETENTIVE FLOATING TABLETS OF CARVEDILOL

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ABSTRACT

In the present investigation, the Carvedilol tablets were formulated by employing Hydrophilic polymers such as HPMC K15, Xanthan gum and Guar gum, Sodium bicarbonate is used as a gas generating agent through wet granulation technique. Among the formulations F1 to F9 the F6 formulation (HPMC K15 and Gaur gum 1:1 ratio) was optimized to get 93% drug release and prolonged the drug release for more than 12hrs. The resulting formulations produced consistent hardness, uniformity in weight and low friability. The formulation with HPMC and Guar gum in the drug and polymer ratio has optimum floating lag time. The optimized formula F6 was fitted to various kinetic models and the result showed that F6 batch followed Zero order kinetics. The mechanism of drug release from F6 batch was Higuchi's with non fickian diffusion pattern. These results indicate that the selected formulation was stable during the period of accelerated stability studies.

KEYWORDS

Carvedilol, Wet granulation technique, HPMC K15, Xanthan gum, Guar gum, Sodium bicarbonate and *In vitro* evaluation.

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INTRODUCTION

Gastro retentive also provides promising way to decrease the side effects of the drug by preventing the fluctuation of the therapeutic concentration of the drug in the body. E.g. treatment of peptic ulcer, etc. In order to overcome the drawbacks of conventional drug delivery systems, several technical advancements have led to the development of controlled and sustained drug

delivery system. To formulate a site-specific orally administered controlled release dosage form, it is desirable to achieve a prolong gastric residence time. Prolonged gastric retention improves bioavailability, increases the duration of drug release, and reduces drug waste[1-2].

Gastro retentive drug delivery is an approach to prolong gastric residence time, thereby targeting site-specific drug release in the upper gastrointestinal tract (GIT) for local or systemic effects. Over the last few decades several gastro retentive drug delivery approaches being designed and developed including: high density (sinking) systems that is retained in the bottom of the stomach, low density (floating) systems that causes buoyancy in gastric fluid, mucoadhesive systems that causes bio adhesion to stomach mucosa, swellable systems which limits emptying of the dosage forms through the pyloric sphincter of stomach[3-4].

Carvedilol is a nonselective β-adrenergic blocking agent with α1-blocking activity. Carvedilol beta-adrenergic receptor blocking ability decreases the heart rate, myocardial contractility and myocardial oxygen demand. Carvedilol also decreases systemic vascular resistance via its alpha adrenergic receptor blocking properties. Carvedilol and its metabolites also prevent OH- radical-induced decrease in sarcoplasmic reticulum Ca2+- ATPase activity. Therefore, Carvedilol and its metabolites may be beneficial in chronic heart failure by preventing free radical damage.

MATERIAL AND METHODS

Materials

Carvedilol Monohydrate and Povidone were obtained as a gift samples from Spectrum Pharma, Hyderabad. HPMC K15M, Xanthan gum, Guar gum, Sodium bicarbonate and Magnesium stearate were obtained as a gift samples from SDFCL, Mumbai. All other chemicals and reagents used were of Analytical grade.

Method

Preparation of floating Tablets

In this present investigation floating tablets of Carvedilol were formulated by wet granulation technique.

Formulation of Carvedilol floating tablets by wet granulation technique[5-6]

Matrix tablets each containing 60 mg of Carvedilol were prepared in different proportions of drug and polymer as per the formulae given in Table No.1. The required quantities of medicament and matrix materials were mixed thoroughly in a glass mortar by following geometric dilution technique. Isopropyl alcohol (1.5%) solution was added and mixed thoroughly to form dough mass. The mass was passed through Sieve No.12 to obtain wet granules. The wet granules were dried at 60^0C. The dried granules were passed through Sieve No.16 mixed with sodium bicarbonate and lubricated with magnesium stearate (1%) and talc (1%). They were passed through mesh No.100 just 4-5 min before compression and blended in a closed polyethylene bag. The tablet granules were compressed into tablets on a rotary multi- station punching machine (Cad mach Machinery Co. Pvt. Ltd., Mumbai) to a hardness of 4-6 kg/sq.cm using 7 mm punches.

PREFORMULATION STUDIES[7]

Preformulation testing is the first step in the rationale development of dosage form of a drug substance. It can be defined as an investigation of physical and chemical properties of a drug substance alone and when combined excipients. It gives extensive information to bring out good quality at high standard at which optimal dosage desired. Preformulation studies were performed on the drug (API), which included solubility and compatability studies.

The following pre formulation studies were performed for Carvedilol and polymers.

Determination of solubility[8]

Practically insoluble in water and dilute acids; freely soluble in methanol, sparingly soluble in ethanol.

Drug and Excipient compatability studies by FT-IR[9]

FT-IR spectroscopy was employed to ascertain the compatability between the Carvedilol and polymers. This KBR Disks were formed by taking drug and KBR in a ratio of 1; 100 respectively Then the mixture was mixed well in mortar Very small amount of this mixture was uniformly spread and sand which between the pellets and pressed using KBR pellets press at a pressure of 20,000psi for 1min the pressure was then released and pellets was then placed in to the pellet holder and thus scanned in I.R region. The scanning range was 40 to 4000 $cm^{-1}$and the resolution was 4 cm^{-1}.

PRECOMPRESSION PARAMETERS[10]

Bulk Density[10]

The powder blend of all formulations was evaluated separately in order to determine their bulk densities. Powder blend was weighed (M) and later the weighed powder blend was transferred in to the measuring cylinder and volume occupied was noted (V_b).

$$D_b = \frac{\text{Mass of t he powder blend (M)}}{\text{Vol occupied by powder blend } (V_b)}$$

V_b is known as the bulk volume and Bulk density is expressed in terms of g/ml.

Tapped Density

Powder blend was transferred into the measuring cylinder and subjected for 100 tapings. The obtained volume was noted as the tapped volume. Tapped density is expressed as g/ml and tapped density is given by the formula:-

$$D_t = \frac{\text{Mass of the powder blend (M)}}{\text{Tapped volume } (V_t)}$$

Angle of Repose[10]

Angle of repose is the maximum angle possible between the surface of the pile of granules and the horizontal plane. This is one of the measures for flow properties. Powder blend was allowed to flow through the funnel attached to a stand and later height and radius of the heap of the powder blend formed was noted. Based on the height and radius obtained Angle of repose was calculated using the formula

$$\tan\theta = \frac{\text{Height of the heap (h)}}{\text{Radius of the heap(r)}}$$

Carr's Index (or) % Compressibility Index

Carr's Index is used to measure the flow properties. It is indicated by the letter (I) and expressed in terms of percentage

$$CI = \frac{\text{Tapped density-bulk density}}{\text{Tapped density}} \times 100$$

Hausner's Ratio

Hausner's ratio was calculated by using the formula;

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

POST COMPRESSION PARAMETERS[6]

Weight Variation

Twenty tablets were weighed collectively and individually. Average weight was calculated and based on the obtained weights % weight variation was calculated using the formula,

$$\%\ \text{Weight Variation} = \frac{\text{Average weight-Individual weight}}{\text{Average weight}} \times 100$$

Hardness Test

Hardness of the tablet was tested by placing the tablet longitudinally in between the two plungers of the Monsanto tablet hardness tester and the obtained hardness was mentioned in terms of kg/sq.cm.

Friability

The friability of the tablets was determined by Roche Friabilator in which the tablets were subjected to the combined effect of abrasions and shock in a plastic chamber revolving at 25 rpm and dropping the tablets at a height of 6 inches in each revolution.

Pre weighed sample of tablets were placed in the friabilator and allowed to rotate for 100 revolutions. Later the tablets were de dusted and the tablets were reweighed. Percent friability is given by the formula;

$$F = (1-W/W_0) \times 100$$

Where,

W_0 = is the weight of the tablets before the test

W = is the weight of the tablets after the test

Estimation of Drug Content

From each batch of prepared tablets, ten tablets were collected randomly and powdered. A quantity of powder equivalent to weight of one tablet was transferred in to a 100 ml volumetric flask, to this 100 ml methanol was added and then the solution was subjected to sonication for about 2 hrs. One ml of the sample was withdrawn suitably diluted with pH 1.2 Hcl and analyzed spectrophotometrically at 241 nm. The solution was filtered and suitable dilutions were prepared with same concentration of the standard solution was also prepared. The drug content was estimated by recording the absorbance at 241 nm by using UV-Visible spectrophotometer.

***In vitro* buoyancy studies**[11]

Floating Lag Time

The floating lag time for all the formulations was tested in dissolution vessel containing 900 ml of 0.1N Hcl solution. Floating lag time and total duration of time by which dosage form remains buoyant is called Total Floating Time (TFT).

Buoyancy study

The *in vitro* buoyancy was determined by floating lag time. The tablets were placed in a 100 ml beaker containing 0.1N Hcl. The time required for the tablet to rise to the surface and float was determined as floating lag time and total duration of time by which dosage form remain buoyant is called Total Floating Time (TFT).

***In vitro* Dissolution studies**[9]

In vitro release studies was carried out using USP XXIV 8 station dissolution rate test apparatus using 900 ml of p^H 1.2 Hcl for a period of 12 hrs at 50 rpm and the temperature was maintained at $37^0C \pm 1^0C$. 5 ml samples were withdrawn at pre determined intervals over 12 hrs, and analyzed spectrophotometrically at 241 nm. 5 ml of fresh dissolution medium was replaced after each sampling in order to maintain sink condition.

Swelling index[12]

The tablets were coated on the lower side with ethyl cellulose (to avoid sticking to the dish) then weighed (W_1) and placed separately in petri dishes. The dishes were stored at room temperature. After 2, 4, 6 and 24 hrs, the tablets were removed and the excess liquid on their surface was carefully removed using filter paper. The swollen tablets were reweighed (W_2) and the index of swelling was calculated by Swelling index = $W_2 - W_1/W_1$.

$$\text{Swelling Index} = \frac{\text{Weight of swollen tablet - Initial weight of tablet}}{\text{Initial weight of tablet}}$$

Drug release kinetics

For a drugs having site specific absorption Different kinetic models (zero-order, first-order, Higuchi's, and Korsmeyer's equation) were applied to interpret the release profile (the order and mechanism of Carvedilol release) from matrix system. To study the mechanism of drug release from the matrix tablets, the release data were fitted to zero-order, first-order, and Higuchi equation.

Kinetics of *In-vitro* Drug Release[13-14]

To study the release kinetics of *in-vitro* drug release, data was applied to kinetic models such as zero order, first order, higuchi and korsmeyer-peppas.

Zero order

$$C = K_0 t$$

Where

K_0 - is the zero-order rate constant expressed in units of concentration/time

t -is the time in hours.

First order

$$\text{Log}C = \text{Log}C_0 - Kt / 2.303$$

Where

C_0 - is the initial concentration of drug,

K - is the first order constant

t - is the time in hours.

Higuchi equation

$$Qt = Kt^{1/2}$$

Where

Q_t - is the amount of the release drug in time t,

K- is the kinetic constant and

t- is time in hours.

Korsmeyer-peppas

$$Mt / M\infty = Kt\, n$$

Where,

M_t - represents amount of the released drug at time t,

M_∞- is the overall amount of the drug (whole dose) released after 12 hrs

K- is the diffusional characteristic of drug/ polymer system constant

n- is a diffusional exponent that characterizes the mechanism of release of drug.

The value of n indicates the drug release mechanism related to the geometrical shape of the delivery system, if the exponent n = 0.5, then the drug release mechanism is Fickian diffusion. If n < 0.5 the mechanism is quasi-Fickian diffusion, and 0.5 < n < 1.0, then it is non-Fickian or anomalous diffusion and when n = 1.0 mechanism is non Fickian case II diffusion, n> 1.0 mechanism is non Fickian super case II.

Accelerated Stability Studies of the Optimized Formulation[14]

It is the responsibility of the manufacturers to see that the medicine reaches the consumer in an active form. So the stability of pharmaceuticals is an important criteria. Stability of medicinal products may be defined as the capability of a particular formulation in a specific container to remain within its physical, chemical, microbial, therapeutic and toxicological specification, i.e. stability of drug is its ability to resists detoriation. 90% of labeled potency is generally recognized as the minimum acceptable potency level. Since the period of stability testing can be as long as two years, it is time consuming and expensive. Therefore it is essential to devise a method that will help rapid prediction of long-term stability of drug.

Stability Studies were carried out at $40^0C \pm 2^0C$ / 75% RH ± 5% RH for a specific time period up to the 30 days for selected formulations. For stability study, the tablets were placed in ambered colored vials and sealed with aluminum foil. These sample containers were placed in desiccators with Maintenance of 75% RH in desiccators 40 ± 1^0C.

(i) 50 ± 1^0C

(ii) (ii) 37 ± 1^0C and

(iii) RH 75% ± 5%.

RESULTS

Preformulation Studies

Determination of solubility

Practically insoluble in water and dilute acids; freely soluble in methanol, sparingly soluble in ethanol.

Drug and Excipient compatability studies by FT-IR

Preformulation studies were carried out through Drug-Excipient compatability studies using FTIR. The IR spectra carvedilol, HPMC and their physical mixture were shown in

Evaluation of Carvedilol Floating Tablets

Pre-compression Parameters

Blend was evaluated for Bulk density, Tapped density, Compressibility indexes, Hausner's ratio, Angle of repose were tabulated in Table No.5. The Pre-compression parameters i.e. Angle of repose 25.32 to 29.73, Bulk density, Tapped density, 0.341-0.347gm/ml and 0.399-0.408 gm/ml, Compressibility index 13.06% and 16.06% and Hausner's ratio1.15-1.160 were found to be within the Pharmacopeia limits indicating good flow properties.

Post compression Parameters

Post-compression parameters i.e.; weight variation, hardness, friability, and percent drug content, were found to be in satisfactory limits the hardness of tablets was tested using hardness tester to find out whether they could retain their physical shape. The measured hardness of tablets of each batch ranged between 4.2 to 6.2kg/cm^2. The values of friability test were tabulated in Table No.6. The % friability was less than 1% in all the formulations. The percentage weight variations for all formulations. (FT1 to FT10) tablets passed weight variation test with Pharmacopeial limits of ±5 % of the weight. For formulation FT1-FT10 density were found to be less than that of the gastric content.

***In vitro* Buoyancy Study of Formulations**

Swelling index

All formulations showed floating lag time between

95 to 240 sec. In the present study, the higher swelling index was found for tablets of batch F1, F6 and F9 containing HPMC and GU. When tablet contacts the test medium, tablet expanded (because of swell able polymers) and there was liberation of CO_2 gas (because of effervescent agent, $NaHCO_3$).

***In vitro* Drug Release Studies**

For a drugs having site specific absorption different kinetic models (zero-order, first-order, Higuchi's, and Korsmeyer's equation) were applied to interpret the release profile (the order and mechanism of Carvedilol release) from matrix system. To study the mechanism of drug release from the matrix tablets, the release data were fitted to zero-order, first-order, and Higuchi equation.

The zero order plots for formulations F1-F9 obtained were linear with regression values of 0.890 and 0.999 when compared with the first order plots. Formulations F1-, F9, exhibited Higuchi's model and the Peppas exponential coefficient i.e. 'n'> 0.5 for the formulations that the release was governed by non Fickian diffusion.

Stability Studies

Stability Studies were carried out at 40^0 C temp and 75% RH for 30 days. The tablets of optimized formulation F6 were packed in amber-colored bottles tightly plugged with cotton and capped and % drug remained un decomposed was checked at regular time intervals.

DISCUSSION

Drug and Excipients compatability were studied by FT-IR spectral analysis the results revealed that there were no interactions between drug and excipients in this investigation for the development of the floating tablet formulation. The Precompression parameters for floating tablets i.e. Angle of repose, Bulk density, Tapped density, Compressibility index, Hausner's ratio were studied and found to be in satisfactory. Postcompression parameters for floating tablets i.e. Weight variation, Hardness, Friability, Drug content, were evaluated and the results obtained were satisfactory. The *in vitro* drug release profile formulated with HPMC & Guar gum (F6) 93.68% was optimized. It was also concluded that the formulations which contains combination of HPMC and Guar gum was more promising in modifying the drug release pattern of formulations as compared to the formulations containing individual polymer with zero order having Higuchi's model and the Peppas exponential coefficient i.e. 'n'> 0.5 by non Fickian diffusion.

Table No.1: General composition of formulation prepared by wet granulation method

S.No	Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9
1	Carvedilol	25	25	25	25	25	25	25	25	25
2	HPMC K15	25	-	-	15	-	15	20	20	-
3	Xanthan gum	-	25	-	15	15	-	-	20	20
4	Guar gum	-	-	25	-	15	15	20	-	20
5	Sodium bi carbonate	15	15	15	15	15	15	15	15	15
6	Povidone	3	3	3	3	3	3	3	3	3
7	Lactose	30	30	30	25	25	25	15	15	15
8	Magnesium Stearate	2	2	2	2	2	2	2	2	2
9	Iso propyl Alcohol	qs	qs	qs	qs	qs	qs	Qs	qs	qs
10	Total weight(mg)	100mg	100mg	100mg	100mg	100mg	100mg	100mg	100mg	100mg

Table No.2: Relationship between angle of repose (θ) and flow ability

S.No	Angle of repose (θ)	Flow ability
1	< 20	Excellent
2	20-30	Good
3	30-34	Passable
4	> 40	Very poor

Table No.3: Relationship between % compressibility and flow ability

S.No	% Compressibility	Flow ability
1	5-15	Excellent
2	12-16	Good
3	18-21	Fair passable
4	23-35	Poor
5	33-38	Very poor
6	> 40	Very very poor

Table No.4: Hausner's Ratio I.P Limits

S.No	Hausner's Ratio	I.P Limits value
1	Excellent	1.00 – 1.11
2	Good	1.1 – 1.18
3	Fair	1.19 – 1.25
4	Possible	1.26 -1.34
5	Very poor	1.35 -1.45
6	Very very poor	>1.60

Table No.5: Results of flow properties of floating tablets

S.No	Formulation code	Bulk density (gm/cc)	Tapped density (gm/cc)	Compressibility index (%)	Hausner's ratio	Angle of repose (θ)
1	F1	0.341	0.406	14.67	1.172	29.42
2	F2	0.34	0.403	15.65	1.185	29.57
3	F3	0.339	0.399	14.94	1.175	29.58
4	F4	0.346	0.398	13.14	1.151	29.74
5	F5	0.347	0.399	13.06	1.150	27.75
6	F6	0.338	0.403	15.98	1.190	26.07
7	F7	0.342	0.408	14.46	1.169	27.18
8	F8	0.343	0.401	14.48	1.163	24.06
9	F9	0.342	0.402	15.04	1.177	28.86

Table No.6: Post compression results of floating tablets

S.No	Formulation	Hardness (kg/cm^2)	Thickness (mm)	Diameter (mm)	Friability (%)	Weight variation
1	F1	5.1	1.37	5.995	0.32	0.205
2	F2	4.9	1.35	6.030	0.45	0.201
3	F3	4.8	1.36	6.022	0.51	0.200
4	F4	5.2	1.25	5.998	0.5	0.199
5	F5	4.8	1.38	6.041	0.37	0.231
6	F6	4.7	1.33	5.997	0.49	0.200
7	F7	5.3	1.35	5.995	0.49	0.213
8	F8	4.7	1.32	6.04	0.41	0.208
9	F9	5.2	1.25	6.05	0.51	0.199

Table No.7: *Invitro* Buoyancy studies for Floating tablets of Carvedilol Formulations

S.No	Formulation	Floating Lag Time (Mints)	Total floating time (hrs)
1	F1	2.64 ± 0.056	>10hrs
2	F2	2.54± 0.073	>10hrs
3	F3	2.13 ± 0.046	>10hrs
4	F4	3.75 ± 0.25	>12hrs
5	F5	2.89 ± 0.078	>12hrs
6	F6	3.47 ± 0.083	>12hrs
7	F7	3.42 ± 0.086	>12hrs
8	F8	3.22 ± 0.072	>12hrs
9	F9	2.27 ± 0.092	>12hrs

Table No.8: Swelling Index of carvedilol floating tablets (F1-F9)

S.No	Formulations code	After 1hr	After 2hr	After 4hr	After 6hr	After 10hr
1	F1	63.22	83.30	20.43	177.77	160.55
2	F2	81.63	59.44	110.13	120.80	185.55
3	F3	82.00	69.72	80.08	184.72	148.25
4	F4	86.50	73.61	121.80	124.60	195.83
5	F5	94.68	56.52	98.47	203.19	171.66
6	F6	106.28	139.86	191.66	185.76	207.66
7	F7	111.30	48.89	130.66	181.76	195.32
8	F8	122.55	60.00	133..33	128.88	168.29
9	F9	138.50	46.55	89.34	130.33	164.32

Table No.9: Swelling index of formulation (F6)

S.No	Time	Initial weight	Final weight	% of Swelling Index
1	0	0	0	0
2	1	0.2	0.54	170
3	2	0.3	0.61	205
4	3	0.2	0.67	235
5	6	0.5	0.71	200
6	10	0.4	0.56	180

Table No.10: Cumulative Percent Drug Release data for carvedilol Formulation (F1toF9)

S.No	Time in hrs	F1	F2	F3	F4	F5	F6	F7	F8	F9
1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1	42.43	34.55	36.29	16.87	13.587	12.469	7.823	7.538	9.481
3	2	56.29	49.35	43.54	28.159	23.687	27.690	17.912	11.359	14.457
4	3	63.86	53.62	57.75	35.37	33.873	36.453	22.754	16.732	19.689
5	4	72.12	63.78	72.23	42.566	46.286	43.542	26.684	23.732	26.432
6	5	84.93	74.33	84.73	49.45	52.122	56.692	29.712	29.43	32.298
7	6	97.57	96.49	93.56	57.25	58.076	62.387	31.327	33.127	37.265
8	7	-	-	-	63.234	62.288	71.566	39.288	38.146	45.809
9	8	-	-	-	72.43	74.165	78.231	41.143	42.967	49.191
10	10	-	-	-	80.343	82.432	87.346	44.143	46.967	56.784
11	12	-	-	-	86.432	89.453	93.68	48.594	52.742	66.456

Table No.11: *In Vitro* Drug Release Kinetics

Correlation Coefficient					Exponential Coefficient				
S.No	**Formulation**	**Zero order**	**First order**	**Higuchi**	**peppas**	**K_0 (mg/h^{-1})**	**$_1$ (h^{-1})**	**K($mg\ h^{-1/2}$)**	**'n'**
1	F1	0.847	0.823	0.981	0.753	18.69	3.39	38.91	0.027
2	F2	0.877	0.854	0.963	0.861	17.34	2.286	34.10	0.089
3	F3	0.904	0.918	0.992	0.897	16.28	3.328	36.05	0.112
4	F4	0.921	0.898	0.963	0.765	9.979	2.248	26.983	0.097
5	F5	0.964	0.914	0.944	0.858	8.228	4.491	24.03	0.108
6	F6	0.979	0.865	0.978	0.927	10.25	3.348	26.493	0.103
7	F7	0.984	0.912	0.983	0.917	4.924	4.949	16.289	0.221
8	F8	0.941	0.876	0.988	0.965	5.732	5.865	13.484	0.028
9	F9	0.991	0.927	0.967	0.921	9.458	6.359	14.630	0.025

Table No.12: Release Mechanism by Mathematical Model

S.No	**Formulation (F6)**	**Kinetics**	
1	ZERO	R^2	0.979
		K_0	10.25
2	FIRST	R^2	0.865
		K_1	3.348
3	HUGCHI	R^2	0.978
		K_H	26.493
4	PEPPAS	R^2	0.927
		N	0.103

Table No.13: Stability Studies of Formulation F6

S.No	Time	Drug content ± sd(mg)	Floating behaviour		Drug release at the end of 12 hr
			Flt (mn)	Floating duration (h)	
1	10days	92.21	3.46	12hr	92.51
2	2 0days	92.18	3.25	12hr	90.124
3	30days	92.03	3.10	12hr	90.12

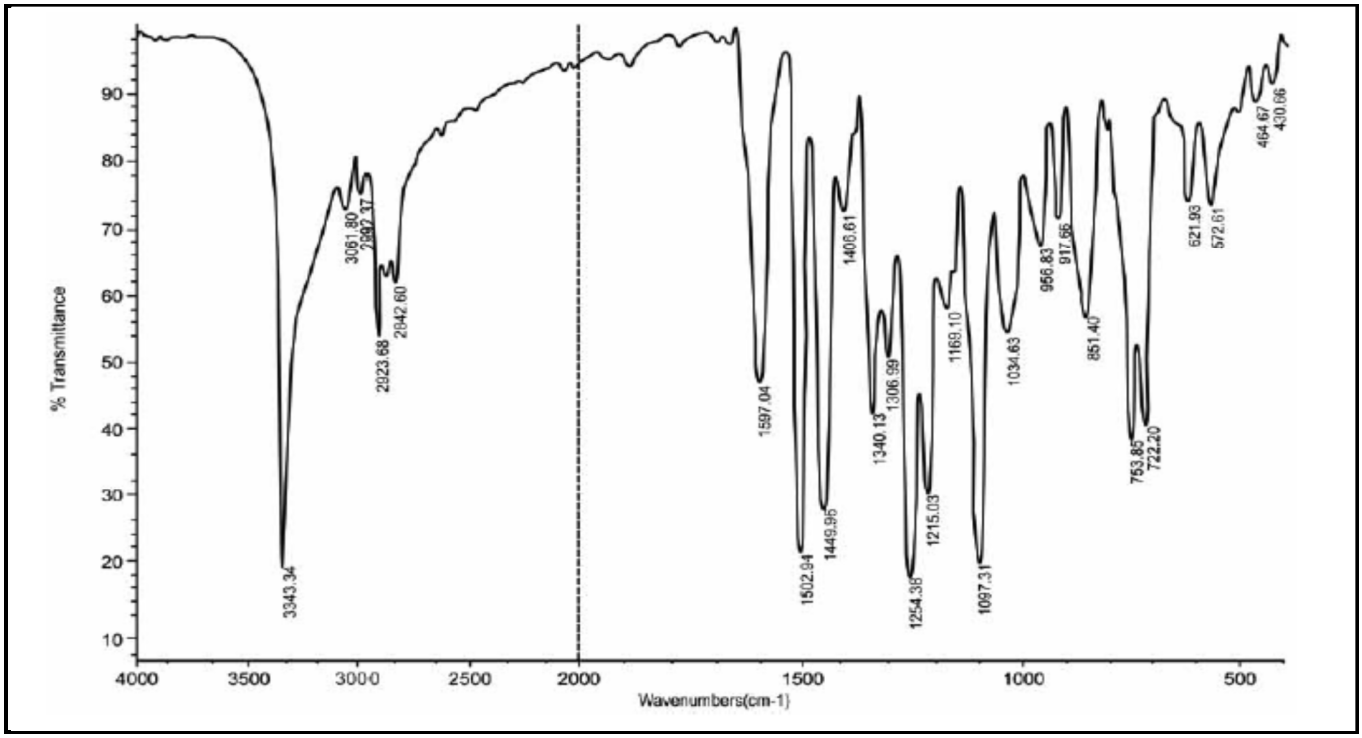

Figure No.1: IR Spectra for Carvedilol

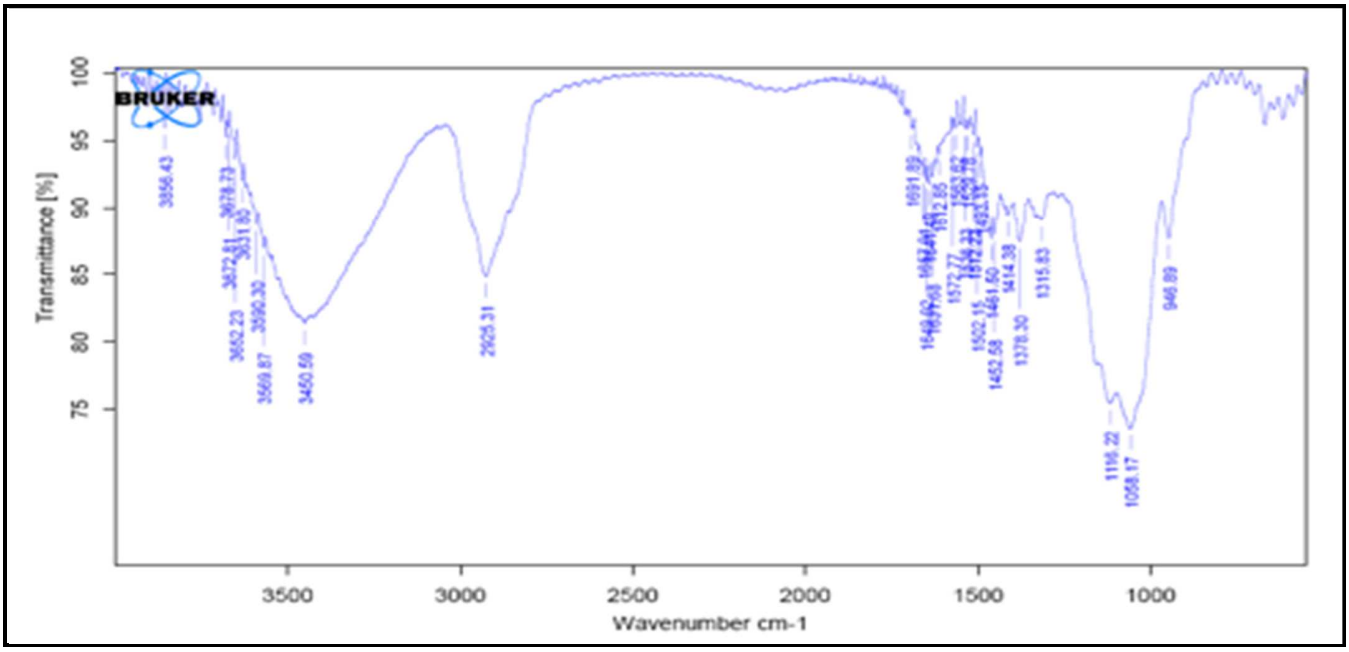

Figure No.2: IR Spectra for HPMCK15M

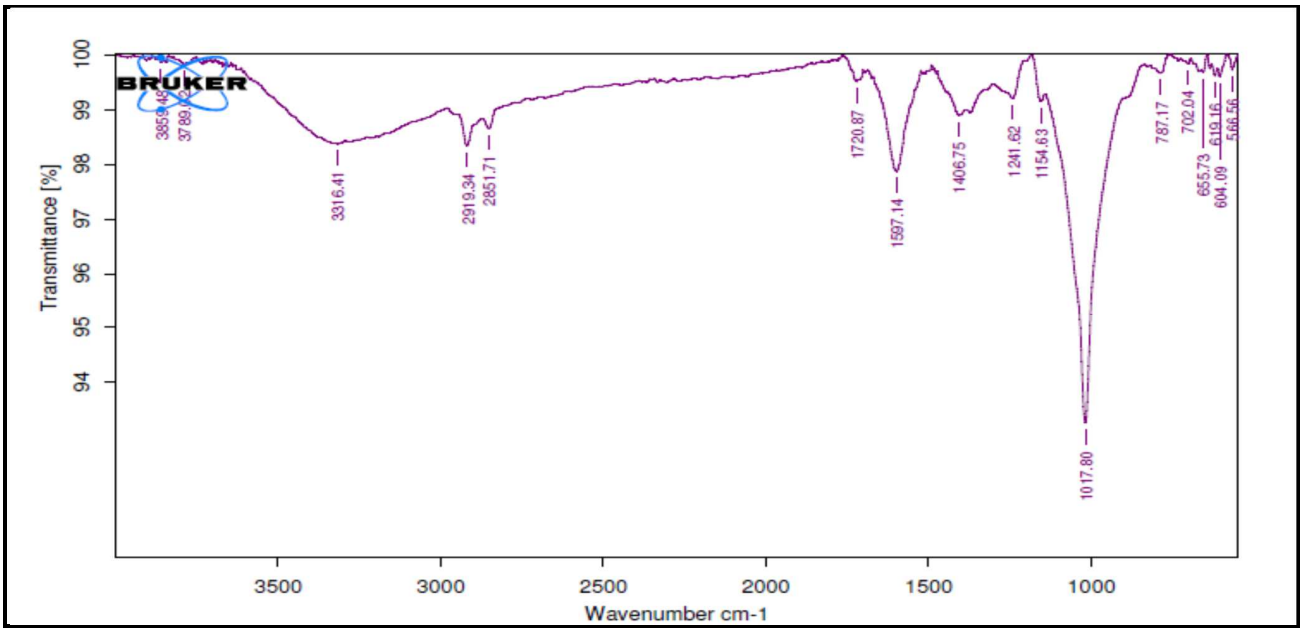

Figure No.3: IR Spectra for Crosspovidone

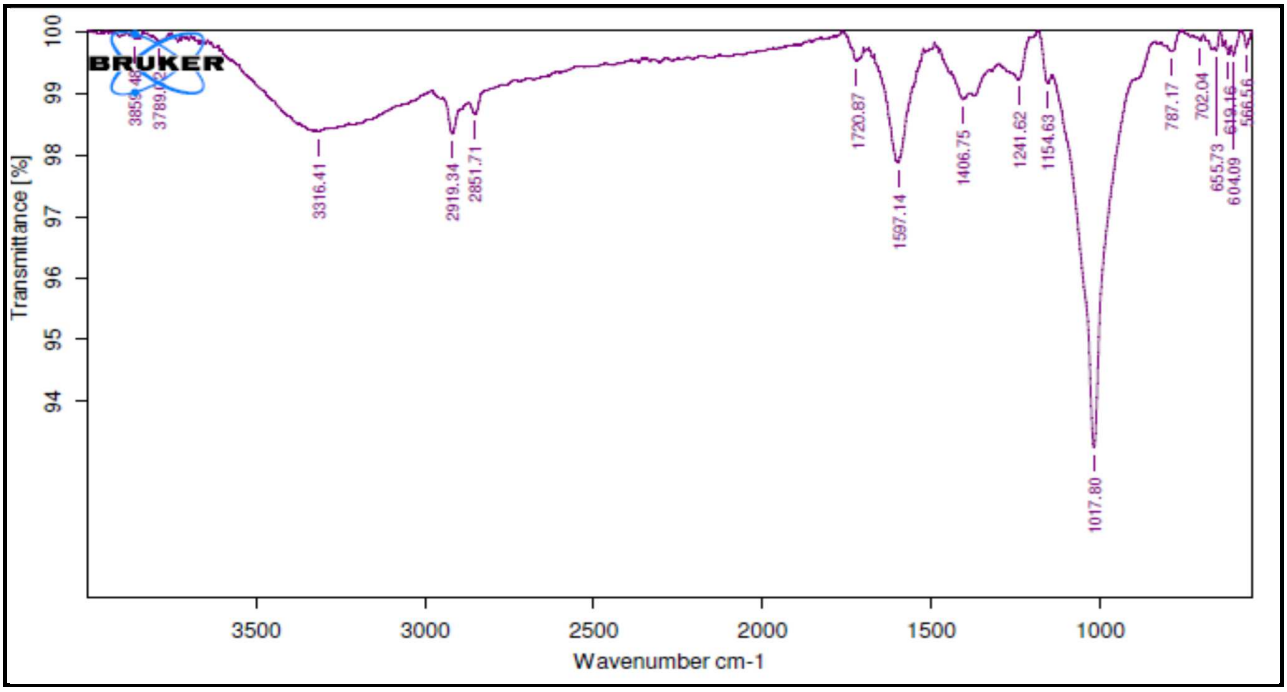

Figure No.4: IR Spectra for Polymer Guar Gum

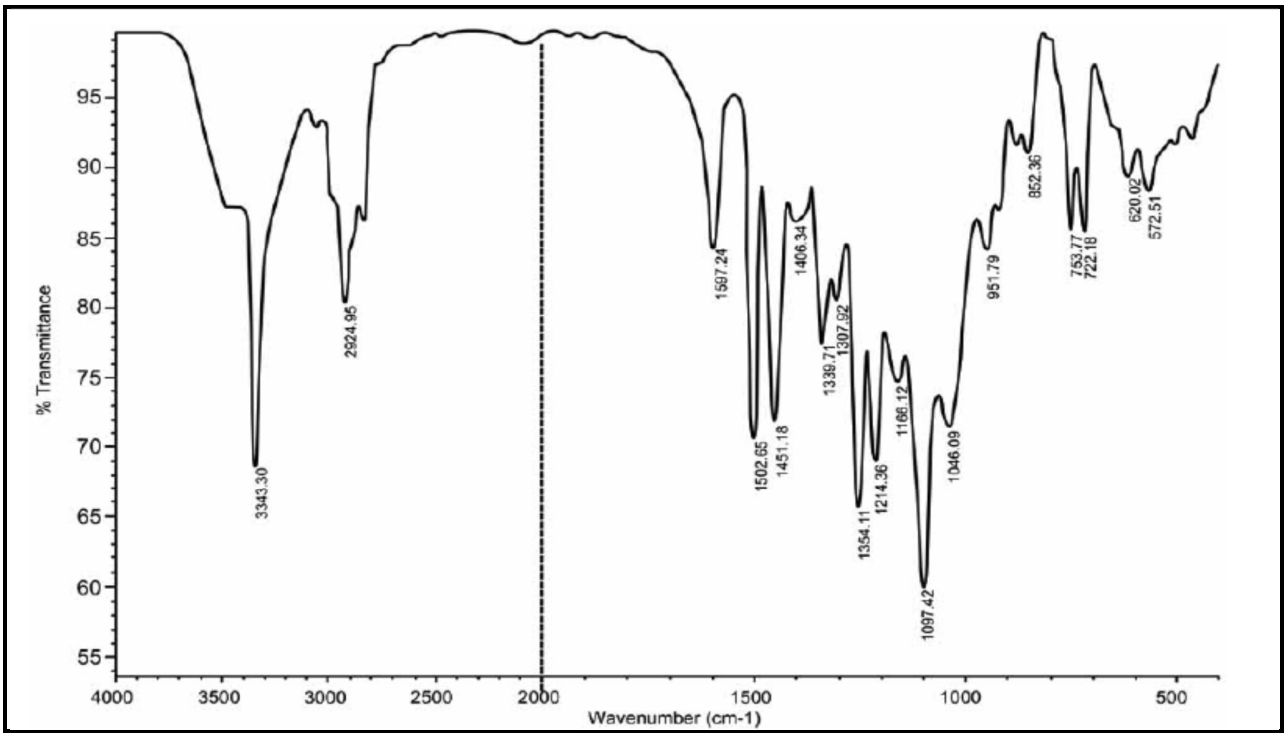

Figure No.5: IR Spectra for Physical Mixture Drug & Polymer HPMC K15M

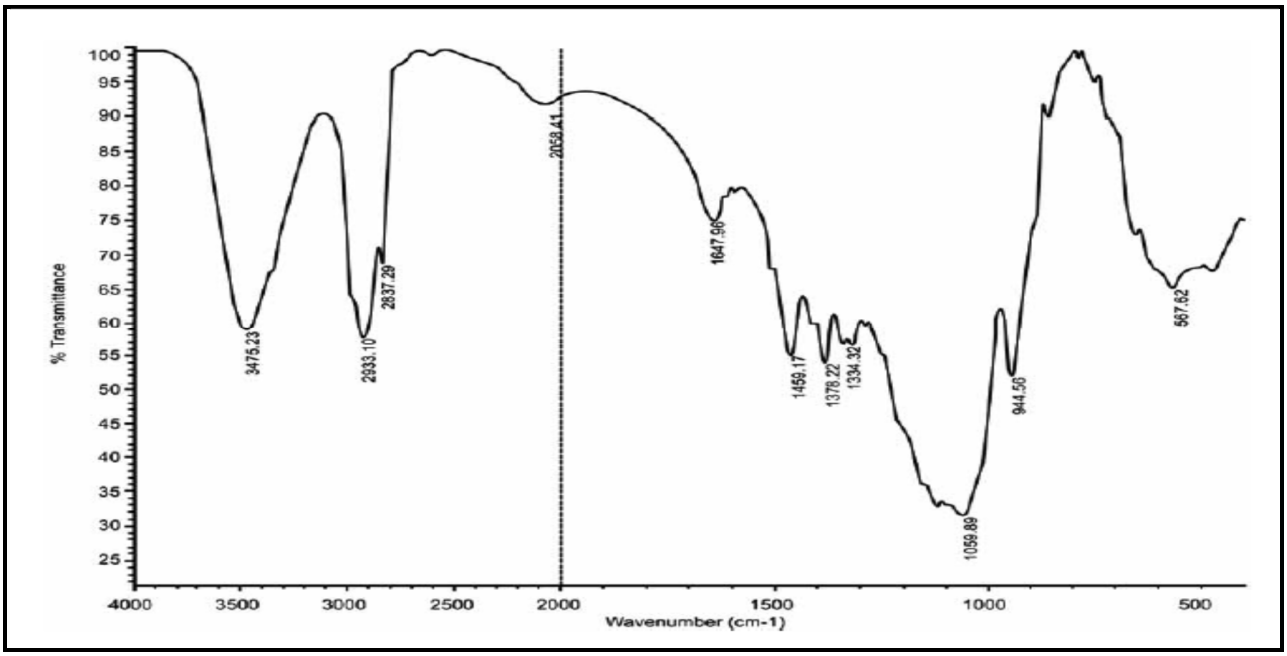

Figure No.6: IR Spectra for Physical Mixture Drug & Polymer Guar Gum

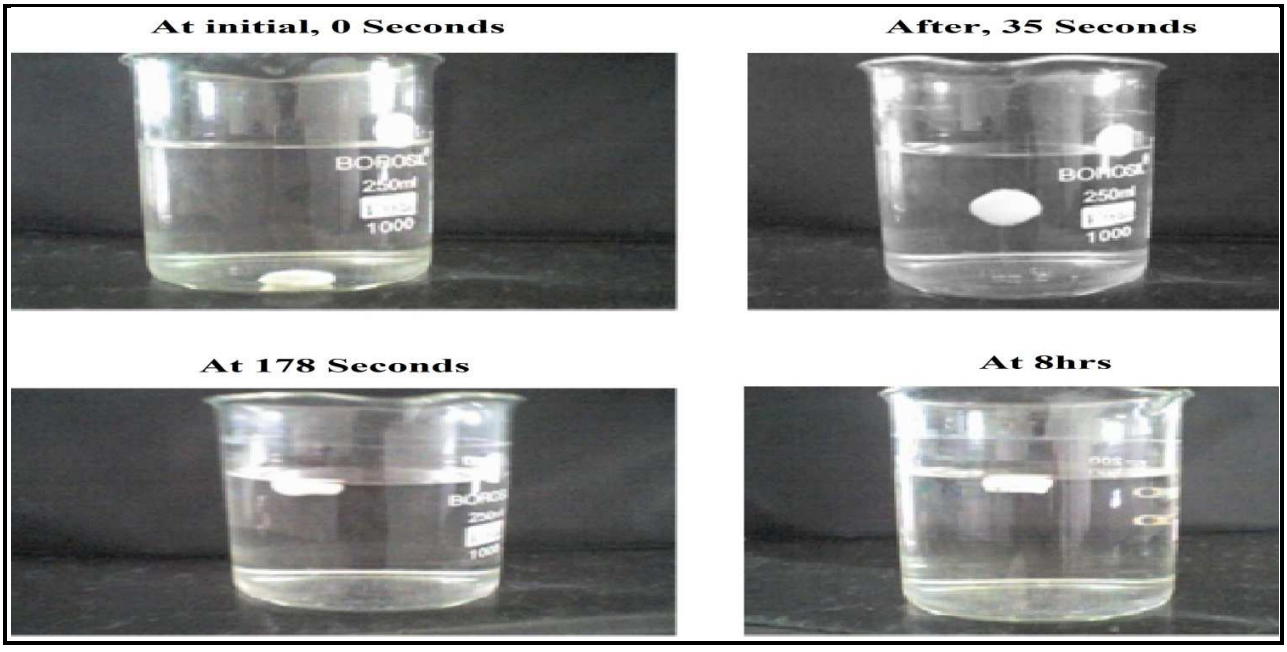

Figure No.7: *Invitro* Buoyancy studies for Floating tablets of Carvedilol Formulations

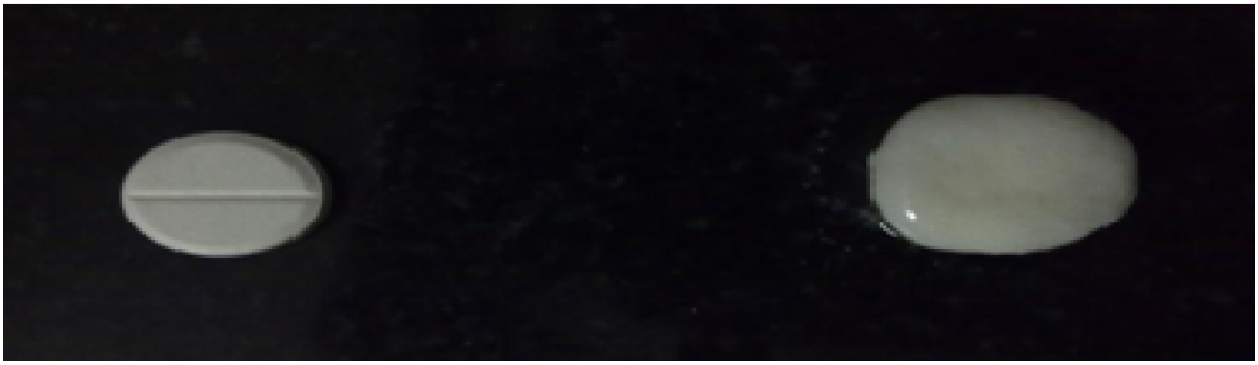

Figure No.8: Swelling index of Carvedilol floating tablets after and before swelling

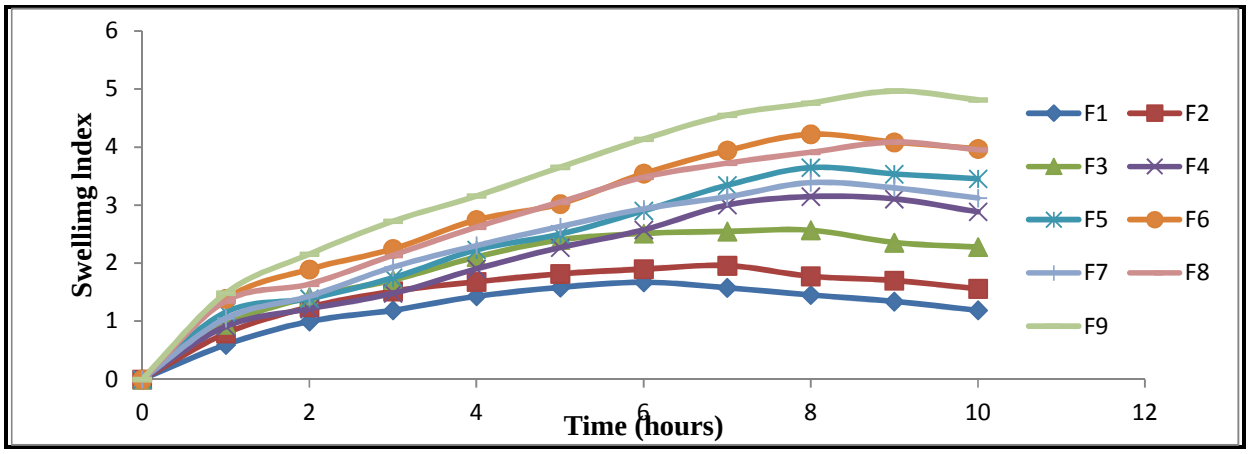

Figure No.9: Swelling index of carvedilol floating tablets (F1 to F9)

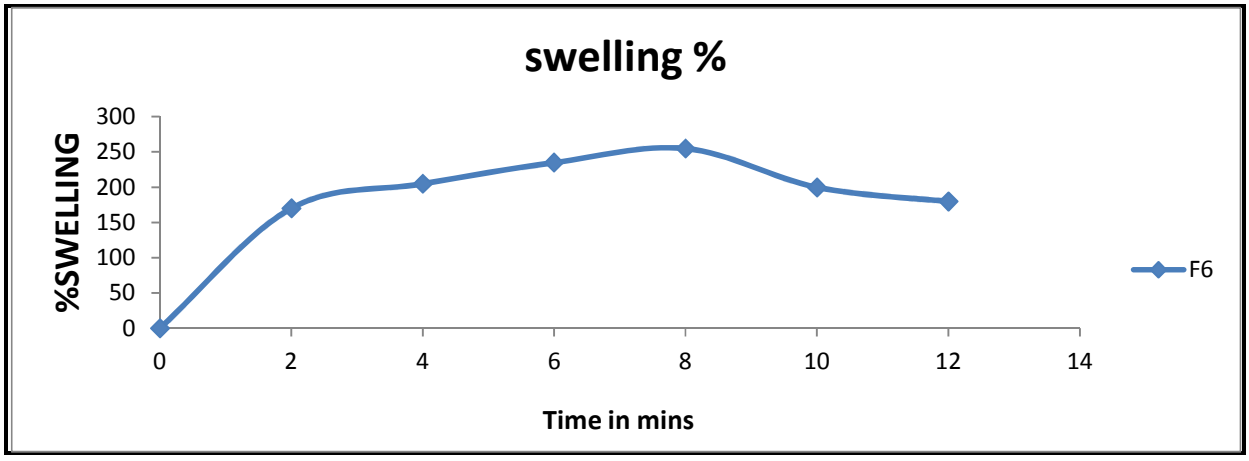

Figure No.10: Swelling % of formulation (F6)

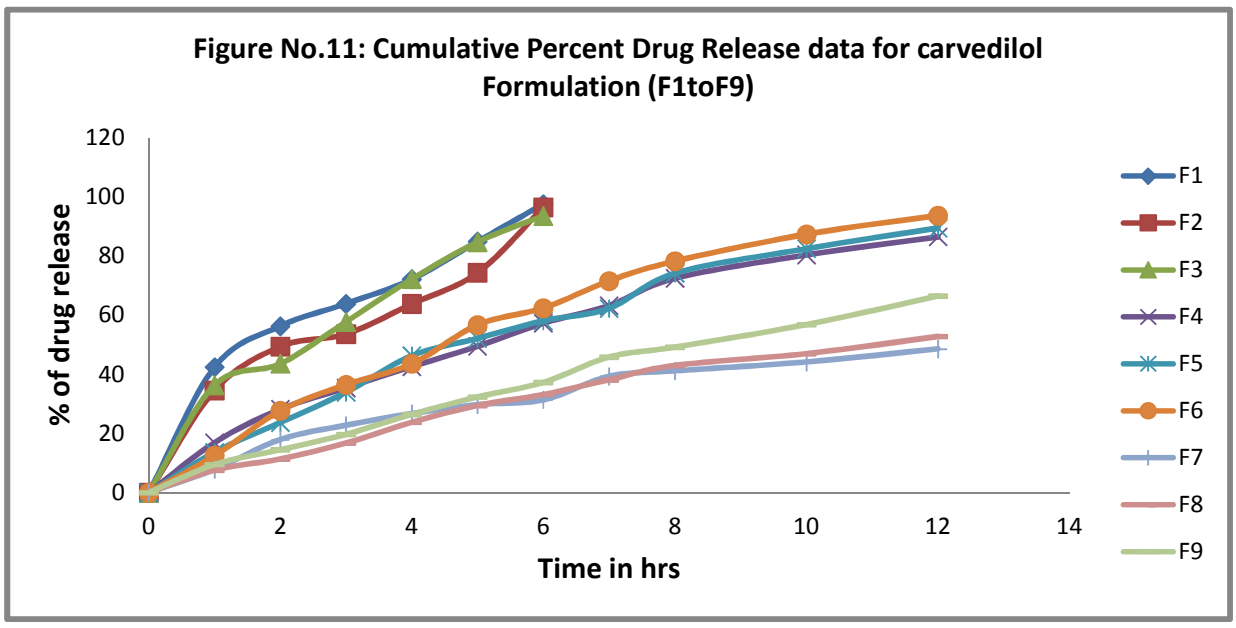

Figure No.11: Cumulative Percent Drug Release data for carvedilol Formulation (F1toF9)

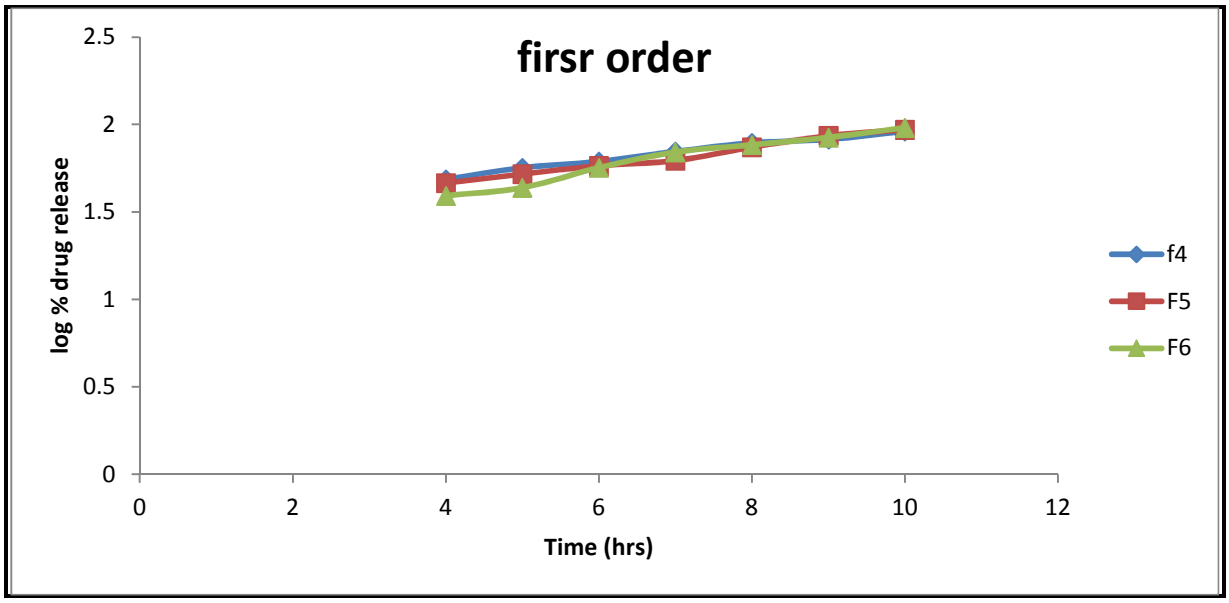

Figure No.12: First Order Plots for Carvedilol floating tablets with HPMC, Guar Gum (F4, F5 and F6)

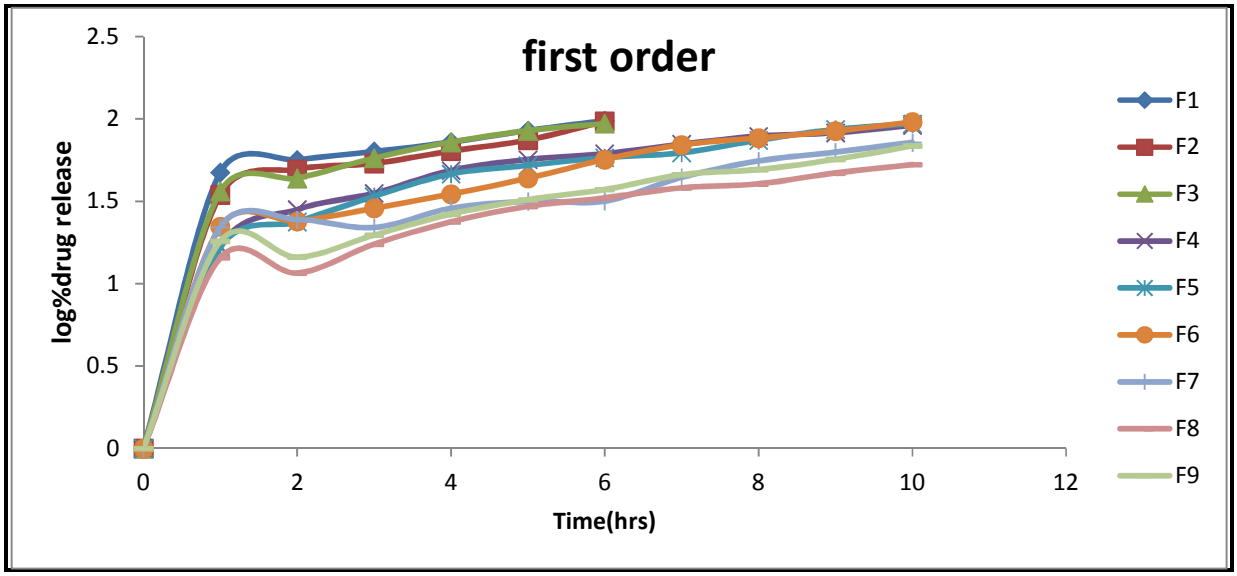

Figure No.13: First Order Plots for Carvedilol floating tablets with HPMC, Guar Gum (F1-F9)

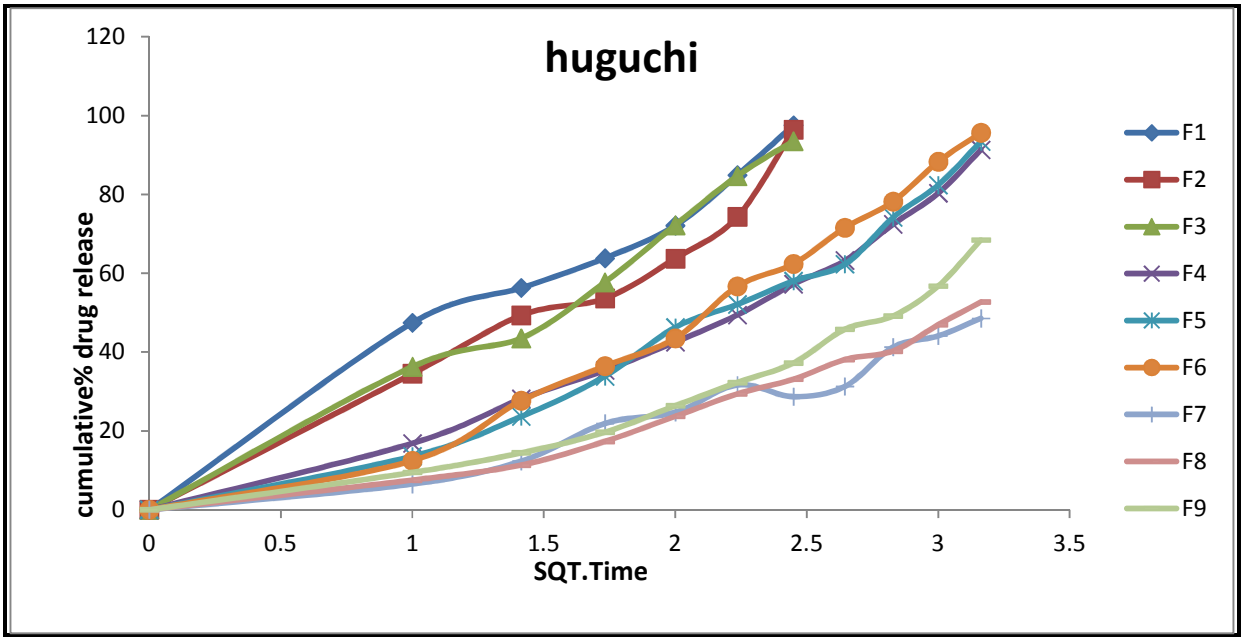

Figure No.14: Huguchi plots for Carvedilol formulations (F1 to F9)

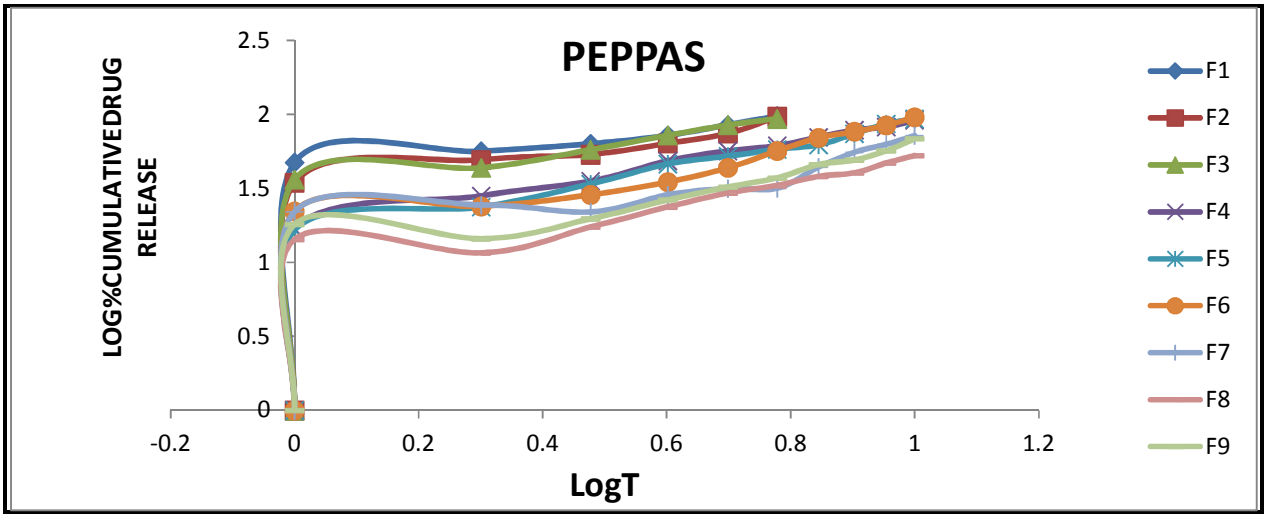

Figure No.15: Peppas Plot for Formulation (F1 to F9)

CONCLUSION

From the compatibility studies, it was concluded that HPMC K15M, Guar gum, Xanthangum were compatible with carvedilol tablets and thus suitable for the formulation of carvedilol floating tablet by wet granulation. In vitro buoyancy studies were performed for all the formulations, F1 to F9 by using 0.1 N Hcl solutions at 37ºC. All the formulations were floated. The formulation F6 containing HPMC K15M, Guar gum show more floating time (12 hours) than other formulations. The formulation F6 showed the controlled drug (93.68%) release above 12 hours. Thus F6 was identified as ideal batch based on its results increase in polymer concentration increases the retardation of drug release from the floating of a carvedilol table. Finally, it was concluded that HPMC K15M, Guar gum, Xanthan gum, Magnesium stearate and sodium bicarbonate can be used as gas generating agent can be successfully used in the formulation of carvedilol sustained release gastro retentive floating drug delivery system.

ACKNOWLEDGEMENT

The authors are sincerely thanks to A.M Reddy Memorial College of Pharmacy, Narasaraopet, Guntur, Andhra Pradesh, India for providing the facilities to complete this research work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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Please cite this article in press as: Sujatha M. *et al*. Formulation and evaluation of gastro retentive floating tablets of carvedilol, *International Journal of Research in Pharmaceutical and Nano Sciences,* 1(2), 2012, 170-189.