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FORMULATION AND EVALUATION OF ROSIGLITAZONE MALEATE FLOATING DRUG DELIVERY SYSTEM

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Abstract: Recent development in novel drug delivery system have brought convince in to reduce dosage frequency. The objective of the present study was to prepare the controlled drug delivery of rosiglitazone maleate to increase the bioavailability and enhance on set of action. Several approaches are currently utilized in the prolongation of the gastric retention time including floating drug delivery system .The fabrication of floating drug delivery system are divided into 2 types a)Noneffervescent system b)Effervescent system. Rosiglitazone maleate is an oral antidiabetic agent. The present study was to formulate floating drug delivery system of rosiglitazone maleate of effervescent type. By using different grades of polymers .different grades of HPMC polymers were used in different proportions to increase the gastric residence time. In theseHPMCK4M, HPMCK15M, HPMCK100M polymers were used to increase the flotation. Our preliminary observation suggest that tablets containing 5-10%HPMCwere able to float in the dissolution medium for only a few hours during dissolution studies. In contrast at higher HPMC level (10-30%), the tablets were able to sustain their floatation over 24hrs. In all formulations it was observed that the increase in the polymer concentration, induce a decrease in the release rate .High concentration of HPMC resulting in more gel formation and forms gelatinous barrier, which may retard the drug release in the formulationsF5, F10, F15 (i.e. 30%HPMC Concentration).

Keywords: Floating Drug Delivery System, Rosiglitazone maleate, HPMC, Wet Granulation, Floating Time.

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INTRODUCTION

Novel Drug Delivery System: It is an established fact that the conventional immediate release drug delivery systems when taken frequently in a day can maintain drug concentration levels in therapeutically effective range.However this results in significant fluctuations in plasma drug levels. Recently, several technical advancements have led to the development of various Novel Drug Delivery Systems (NDDS) that could revolutionize method of drug delivery and hence could provide definite therapeutic benefits[1, 2]

Gastro retentive Drug Delivery System[3]: Oral controlled drug delivery system should be primarily aimed at achieving more predictable and increased bioavailability of drugs. However, the development process is precluded by several physiological difficulties, such as an inability to restrain and localize the DDS within desired regions of the GI tract and the highly variable nature of gastric emptying process. It can be anticipated that, depending upon the physiological state of the subject and the design of pharmaceutical formulation, the emptying process can last from a few minutes to 12 hrs. The relatively brief gastric emptying time in humans, which normally averages 2-3 hrs through the major absorption zone (stomach or upper part of the intestine), can result in incomplete drug release from the DDS leading to diminished efficiency of the administered dose. Thus, control of placement of a DDS in a specific region of the GI tract offers numerous advantages, especially for drug with a stability problem. Overall, the intimate contact of the DDS with the absorbing membrane has the potential to maximize drug absorption and may also influence the rate of drug absorption. These considerations have lead to the development of oral controlled release dosage forms possessing gastric retention capabilities.

Gastro Retentive Dosage Form (GRDF) will also greatly improve the pharmacotherapy of the stomach itself through local drug release leading to high drug concentrations at the gastric mucosa, which are sustained over a long period of time. For example, eradication of *Helicobacter pylori*, which requires the administration of various medications several times a day according to a complicated regimen and which frequently fails as a result of insufficient patient compliance, could perhaps be achieved more reliably using GRDF to administer smaller drug doses for fewer times.

Rosiglitazone maleate is a white to off white solid, which is not chemically or functionally related to the sulfonylureas, the biguanides, or the I - glycosidase inhibitors.

Rosiglitazone maleate is an oral antidiabetic agent, which acts primarily by increasing insulin sensitivity. It is effective only in the presence of insulin. It decreases insulin resistance at peripheral sites and in the liver. This results in insulin-dependent glucose disposal and decreased hepatic glucose output. These effects are accomplished by selective binding at the

Peroxisome Proliferator-activated receptor-gamma (PPAR-gamma), which is found in adipose tissue, skeletal muscleand the liver. Activation of these receptors modulates transcription of several insulin responsive genes that control glucose and lipid metabolism.

Approaches for Gastric Retention[3]:

A. **Floating System (Low Density Approach):** These systems are also known as hydro dynamically balanced systems (HBS/FDDS). They have a bulk density lower than gastric fluid, i.e. their bulk density is less than one.

B. **High density Systems:** High density formulations include coated pellets that have density greater than that of stomach contents. (~1.004g/cm^3) This is accomplished by coating the drug with heavy inert materials such as barium sulfate, titanium dioxide, iron powder or oxide. The weighted pellet can then be covered with a diffusion-controlling polymer membrane.

C. **Swelling and expanding systems**: Swelling type dosage forms are such that after swallowing, these products swell to an extent that prevents their exit from the stomach through the pylorus. As a result, the dosage form is retained in the stomach for a long period of time. These systems may be referred to as 'plug type' systems since they exhibit tendency to remain lodged at the pyloric sphincter.

D. **Bio-adhesive systems**: They are used to localize a delivery device within the lumen and cavity of the body to enhance the drug absorption process in a site-specific manner. It makes use of bio- adhesive polymers. These polymers tend to form hydrogen and electrostatic bonds at the mucus polymer boundary.

E. **Modified- shape systems**: These are non-disintegrating geometric shapes molded from silastic elastomer or extruded from polyethylene blends which extend the GRT depending on size, shape and flexural modulus of the drug delivery system.

F. **Use of other delayed gastric emptying devices:** It includes sham feeding of indigestible polymers or fatty acid salts that change the motility pattern of the stomach to a fed state, thereby decreasing the gastric emptying rate and permitting considerable prolongation of drug release.

G. **Osmotic Regulated System:** It is comprised of an osmotic pressure controlled drug delivery device and an inflatable floating support in a bioerodible capsule. In the stomach the capsule quickly disintegrates to release the intragastricosmotically controlled drug delivery device. The inflatable support inside forms a deformable hollow polymeric bag that contains a liquid that gasifies at body temperature to inflate the bag. The osmotic pressure

controlled drug delivery device consists of two components; drug reservoir compartment and osmotically active compartment.

H. **Incorporation of passage delaying food agents[2]:** The food excipients like fatty acids, e.g. salts of myrestic acid change and modify the pattern of the stomach to a fed state, thereby decreasing gastric emptying rate and permitting considerable prolongation of release. The delay in the gastric emptying after meals rich in fats is largely caused by saturated fatty acids with chain length of C_{10}-C_{14}.

I. **Ion Exchange Resin[4]:** A coated ion exchange resin bead formulation has been shown to have gastric retentive properties, which was loaded with bicarbonates. Ion exchange resins are loaded with bicarbonate and a negatively charged drug is bound to the resin, resultant beads were then encapsulated in a semipermeable membrane to overcome the rapid loss of carbon dioxide. Upon arrival in the acidic environment of the stomach and exchange of chloride and bicarbonate ions take place. As a result of this reaction carbon dioxide was released and trapped in a membrane thereby carrying beads towards the top of gastric content and producing a floating layer of resin beads in contrast the uncoated beads, which will sink quickly.

MATERIALS AND METHODS:

MATERIALS:

Rosiglitazone maleate , HPMC K 4 M, HPMC K 15 M, HPMC K 100 M , Sodium bicarbonate, Stearic acid, Magnesium stearate, Dicalcium phosphate, Talc, Polyvinyl pyrrolidone .

METHODS:

Preparation of Matrix Tablets:

The matrix tablet contains uniform mixture of drug, polymer and other excipients including gas-generating agent. The tablets were prepared by wet granulation technique. Weighed quantities of drug, polymer, diluent and sodium bicarbonate were mixed properly in a mortar. Weight granulation was made by using 7.5 % ethanolic solution of Polyvinyl Pyrolidone. Wet mass was passed through sieve (16) and prepared granules were air dried and kept in desiccators for 1 day. Dried granules were again passed through sieve (40).

Granules before few minutes of compression were mixed with talc and magnesium stearate in amber colored bottle. The well-mixed granules equivalent to 200 mg were compressed using a sixteen station rotary tablet compression machine. Hardness of tablets was kept content at 8 kg/cm2. Formulation F1 to F15 indicates matrix tablets with diameter 8.5 mm.

The effect of matrix tablet diameter on floating lag time, swelling characteristics and In vitro drug release rate was studied. Formulations are shown in tables 2, 3 & 4.

EVALUATION OF GRANULES [7,13,14]:

Angle of repose:

Angle of repose has been defined as the maximum angle possible between the surface of pile of powder and horizontal plane. The angle of repose for the granules of each formulation was determined by the funnel method. The granules mass was allowed to flow out of the funnel orifice on a plane paper kept on the horizontal surface. This forms a pile of angle of granules on the paper. The angle of repose was calculated by substituting the values of the base radius 'R' and pile height 'H' in the following equation:

$\tan\theta = H / R$

$$\text{Therefore; } \theta = \tan^{-1} (H / R)$$

Flow Rate:

Flow rate of a powder has been defined as the rate at which the particular mass emerges through the orifice of funnel of a suitable diameter. The flow rate for granules of each formulation was determined by pouring accurately weighed quantities of granules in funnel with an orifice of 8 mm diameter. The time required for the complete granule mass to emerge out of the orifice was recorded using a stopwatch. The flow rate was calculated from following equation:

$$\text{Flow rate} = \frac{Weight\ of\ granules}{Time\ in\ Seconds}$$

Bulk Density:

The bulk density was obtained by dividing the mass of a powder by the bulk volume in cm^3. The sample of about 50 cm^3 of powder, previously been passed through a standard sieve no. 20, was carefully introduced into a 100 ml graduated cylinder. The cylinder was dropped at 2-second intervals onto a hard wood surface three times from a height of 1 inch. The bulk density of each formulation was then obtained by dividing the weight of sample in grams by the final volume in cm^3 of the sample contained in the cylinder. It was calculated by using equation given below:

$D_f = M / Vp$

Where,

D_f = bulk density

M = weight of samples in grams

Vp = final volumes of granules in cm^3

Tapped Density:

The tapped density was obtained by dividing the mass of a powder by the tapped volume in cm^3. The sample of about 50 cm^3 of powder, previously been passed through a standard sieve no. 20, is carefully introduced into a 100 ml graduated cylinder. The cylinder was dropped at 2-second intervals onto a hard wood surface 100 times from a height of 1 inch. The tapped density of each formulation was then obtained by dividing the weight of sample in grams by the final tapped volume in cm^3 of the sample contained in the cylinder.

Carr's Index:

An indirect method of measuring powder flow from bulk densities was developed by Carr. The percentage compressibility of a powder was a direct measure of the potential powder arch or bridge strength and stability.

Evaluation of tablets

Tablet Thickness and Diameter[8]:

Thickness and diameter of tablets were important for uniformity of tablet size. Thickness and diameter were measured using digital vernier calipers.

Tablet Hardness[8]:

The resistance of tablets to shipping or breakage, under conditions of storage, transportation and handling before usage depends on its hardness. The hardness of tablet of each formulation was measured by Monsanto hardness tester. The hardness was measured in terms of kg/cm^2.

Friability[8]:

Friability is the measure of tablet strength. Roche friabilator was used for testing the friability using the following procedure.

Twenty tablets were weighed accurately and placed in the tumbling apparatus that revolves at 25 rpm dropping the tablets through a distance of six inches with each revolution. After 4 min., the tablets were weighed and the percentage loss in tablet weight was determined.

$$\% \text{ loss} = \frac{\text{Initial wt.of tablets} - \text{Final wt.of tablets}}{\text{Initial wt.of tablets}} \times 100$$

Uniformity of Weight[9]:

Weigh 20 tablets selected at random and calculate the average weight. Not more than two of the individual weights deviate from the average weight by more than the percentage shown in Table No.5.5: and none deviates by more than twice that percentage.

Uniformity of content[9]:

This test was applicable to tablets that contain less than 10 mg or less than 10 % w/w of active ingredient. Content of active ingredient in tablets and capsules, taken at random, was determined. Crush tablets and powder equivalent to weight of tablet dissolved in 0.1 N HCL. In case of capsules remove the hard gelatin shells and powder equivalent to 15.2348 mg of drug and dissolved it in hot 0.1 N HCL. Drug content was calculated by measuring absorbance at wavelength 318.5 nm.

Matrix Integrity[10]:

The swollen mass of the tablets remain intact or not was checked. Matrix integrity was observed throughout *In vitro* dissolution studies.

Floating Lag Time[10]:

This test was performed in beaker containing 100 ml 0.1 N HCL as a testing medium maintained at 37^0C. The time required for the tablet to rise to the surface and float was determined as floating lag time.

Floating Time[10]:

Floating time was the time, the tablet floats in dissolution medium (including floating lag time).

Swelling Characteristics[4]

The swelling properties of HPMC matrices containing drug were determined by placing the tablet matrices in the dissolution test apparatus, in 900 ml of 0.1 N HCL at $37 \pm 0.5\ ^0$C.

The tablets were removed periodically from dissolution medium. After draining free water these were measured for weight gain, thickness and diameter. Swelling characteristics were expressed in terms of percentage water uptake (WU %) according to the equation,

$$\text{WU\%} = \frac{\text{Wt.of swollen tablet} - \text{Initial wt.of the tablet}}{\text{Initial wt.of the tablet}} \times 100$$

Dissolution Studies[10,12]:

The release rate of Rosiglitazone maleate from floating tablets was determined using USP Dissolution Testing Apparatus II (Paddle type). The dissolution test was performed using 900 ml of 0.1 N HCL, at 37 ± 0.5^{0}C and 50 rpm. A sample (10 ml) of the solution was withdrawn from the dissolution apparatus hourly for 9 hrs, and the samples were replaced with fresh dissolution medium. The samples were filtered through Whatman filter paper no. 41. Absorbance of these solutions was measured at 318.5 nm. Cumulative percentage drug release was calculated using an equation obtained from a standard curve.

Details of Dissolution Test:

1. Apparatus : USP Type II
2. Volume of medium : 900 ml
3. Temperature : 37^{0}C
4. Paddle Speed : 50 rpm
5. Dissolution medium used : 0.1 N HCL
6. Aliquot taken at each time interval : 10 ml

RESULTS AND DISCUSSION:

Compatibility studies of drug and polymers: From the spectra of pure drug and the combination of drug with polymer, it was observed that all the characteristic peaks of ROSIGLITAZONE MALEATE were present in the combination spectrum, thus indicating compatibility of the drug and polymers. Rosiglitazone maleate showed characteristic peaks of aromatic C-H stretching at 3008-3043cm^{-1}, NH stretching of secondary amine salt at 1759-2999 cm^{-1}. Rosiglitazone maleate also showed peak at 1710 cm^{-1} due to carbonyl stretching of = C = O and peak at 1500 cm^{-1} due to aromatic C=C stretching. Rosiglitazone maleate showed peak at 744.47 cm^{-1} due to disubstituted Benzene ring. Obtained frequencies and predicted groups confirm that the drug was Rosiglitazone maleate.

Determination of λmax and preparation of standard calibration curve of rosiglitazone maleate:

Rosiglitazone maleate showed maximum absorption at wavelength 318.5 nm in 0.1 N HCL. Calibration curve was done by taking absorption of diluted stock solutions at wavelength 318.5 nm. Shown in Table 1 and Figure 1.

Evaluation of granules:

Granules of matrix tablets showed angle of repose from 15.52 ± 2.63 to 40.60 ± 1.81, flow rate 0.89 ± 1.57 to 1.23 ± 1.03 gm/min and Carr's index 11.11 ± 2.81 to 29.41± 0.97.

Data given in Table No.5 indicates that as concentration of HPMC increases angle of repose and Carr's index were increases and flow rate was decreases.

Evaluation of tablets:

1) Tablet thickness and diameter:

Diameter and thickness (Table No.6) of formulations F1 to F15 varying from 13.02 ± 3.81 to 13.14 ± 1.27 mm and 1.16 ± 2.09 to 1.43 ± 1.14 mm, respectively.

2) Tablet hardness: Hardness of tablets of each formulation was measured and found in the range of 8 ± 0.96 to 8.5 ± 1.24 kg/cm^2. Each sample was analyzed in triplicate.

3) Friability: Percentage weight loss of the tablets of each formulation was measured and found in the range of 0.2 ± 1.23 to 0.6 ± 1.96 %.

4) Matrix integrity: Matrix integrity of tablets found to be remains intact throughout dissolution study for most of the formulation. Each sample was analyzed in triplicate.

5) Floating lag time: The buoyancy lag time of tablets depend on amount of sodium bicarbonate involved in CO_2formation. For the floating system the ideal matrix or coating material should be highly permeable to dissolution media in order to initiate rapid generation of CO_2 and should be permeable for CO_2 to promote floating. Formulation F1 to F15 (8.5 mm diameter) showed buoyancy lag time ranges from 3.41 ± 1.39 to 15.5 ± 2.01 min.Results indicate that FLT was found to be decreased with increase in the concentration of HPMC with in all tablet formulations. Results are shown in table 7.

6) Floating time: Floating time was found to be dependent on HPMC content. HPMC was a swelling polymer and degree of gelling and gel strength determines its buoyancy.

7) Swelling characteristics: The percentage water uptake of the formulations F1 to F15 ranges 98.73 to 198.00 % the percentage water uptake was found to be improved by increasing

concentration of HPMC in the formulation. Tablets Thickness and diameter was found to be increased in swelling characteristics study. Results are shown in table 8.

8) **Dissolution study of matrix floating units:** Matrix floating tablets were prepared by using three viscosity grades of HPMC. Almost 15 formulations were prepared by using five different concentrations of each viscosity grade of HPMC. Results are shown in table 9.

Batches F1 to F5 (10 – 30 %) were formulated to study the effect of HPMC K 4 M concentrations, where as F6 to F10 (10 – 30 %) were formulated to study the effect of HPMC K 15 M concentrations. In the batches F11 to F15 (10 – 30 %) HPMC K 100 M was used in various concentrations.

The figures 2 3& 4 shows the Rosiglitazone maleate cumulative percentage released graphed versus time for the different Rosiglitazone maleate floating tablet formulations. Compared to conventional tablets, all formulations tested showed sustain release pattern of drug over 9 hrs with varying cumulative percentage release.

As expected the drug release was dependent on the concentration of HPMC in all formulations. In the bathes F1 to F5, formulation F1 showed all 99.5 % release and formulation F5 showed 78.094 % release in 9 hrs.In the batches of HPMC K 15 M, formulations F6, F7, F8, F9 and F10 showed 90.426, 83.281, 70.583, 63.487 and 61.47 % drug released in 9 hrs dissolution studies respectively. Formulations F11 to F15 showed 70.93, 65.38, 65.61, 62.06 and 54.523 % drug released, respectively. In all formulations it was observed that the release rate of drug was a function of HPMC K 4 M, HPMC K 15 M and HPMC K 100 M content. An increase in the polymer concentration, induce a decrease in the release rate. High concentration of HPMC resulting in the more gel formation and forms a gelatinous barrier, which may retard the drug release in the formulations F5, F10 and F15 (i.e. 30 % HPMC concentration)

Ratio of HPMC in the matrix was the key factor in controlling the drug release in all formulations. As seen from figures 2, 3 & 4 the higher the ratio of HPMC, slower the drug release was observed.

Three different viscosity grades of HPMC were to evaluate effect of polymer on release rate of drug. The resent study was carried out keeping concentration of polymer constant.

As seen from figures 5, 6, 7, 8 & 9 it was found that in all cases HPMC K 100 m showed slow release rate as compared to HPMC K 15 M and HPMC K 4 M.

Tablets of all formulations remained floating and appeared swollen until the end of dissolution test. The drug release rate was found to be dependent on the viscosity grade of polymer used.

Formulations F11, F12, F13, F14 and F15 (HPMC K 100 M) showed the lowest drug release rate than formulations F6, F7, F8, F9 and F10 (HPMC K 15 M), where as formulations F1, F2, F3, F4 and F5 (HPMC K 4 M) showed highest drug release rate amongst all the formulations.

CONCLUSION

Friability, uniformity of content and weight of tablets complied with IP limit. Floating lag time of tablets depends on concentration of sodium bicarbonate, type and concentration of polymer. As concentration of sodium bicarbonate and polymer increased floating lag time decreased. Use of high viscosity polymer can also decrease the floating lag time but, this use of high viscosity polymer increase the matrix integrity and resultant weight of tablets. Concentration and viscosity of polymer should directly proportional relationship with swelling characteristics of tablets. In dissolution study of all formulations it was observed that by increasing concentration of polymers and increasing viscosity of polymers, release rate of drug was retarded. The optimized formulations subjected to 100% dissolution study and this study showed release retardation over 16-22 hrs. The formulation F 15 which gave release retardation up to 22hrs was nominated as best formulation.

Table No 1: Preparation of standard solution of Rosiglitazone maleate

CONCENTRATION	ABSORBANCE
0	0
10	0.192
20	0.38
30	0.579
40	0.763
50	0.967

Table No 2: Formulations of matrix tablet

Ingredients	F1	F2	F3	F4	F5
Drug	15	15	15	15	15
HPMC K4 M	10	15	20	25	30
DCP	29	24	19	14	9
$NaHCO_3$	32	32	32	32	32
Stearic acid	12	12	12	12	12
Magnesium stearate	1	1	1	1	1
Talc	1	1	1	1	1

Table No 3: Formulation of matrix tablets

Ingredients	F6	F7	F8	F9	F10
Drug	15	15	15	15	15
HPMC K15 M	10	15	20	25	30
DCP	29	24	19	14	9
$NaHCO_3$	32	32	32	32	32
Stearic acid	12	12	12	12	12
Magnesium stearate	1	1	1	1	1
Talc	1	1	1	1	1

Table No 4: Formulation of matrix tablets

Ingredients	F11	F12	F13	F14	F15
Drug	15	15	15	15	15
HPMC K100 M	10	15	20	25	30
DCP	29	24	19	14	9
$NaHCO_3$	32	32	32	32	32
Stearic acid	12	12	12	12	12
Magnesium stearate	1	1	1	1	1
Talc	1	1	1	1	1

Table No. 5: Evaluation of granules of matrix tablet

Sr. No.	Angle of Repose	Flow Rate (gm/min)	Bulk Density (gm/cm^3)	Tapped Density (gm/cm^3)	Carr's Index
F1	24.44 ± 2.97	1.23 ± 1.03	0.7143 ± 2.16	0.8333 ± 1.97	14.28 ± 2.89
F2	29.05 ± 2.63	1.08 ± 1.59	0.6666 ± 2.25	0.7692 ± 2.28	15.39 ± 1.96
F3	33.69 ± 1.34	0.96 ± 1.36	0.7142 ± 1.40	0.9090 ± 2.99	21.43 ± 1.99
F4	36.86 ± 3.40	0.95 ± 0.64	0.6666 ± 1.73	0.8333 ± 1.56	20.00 ± 0.67
F5	40.60 ± 1.81	0.93 ± 2.93	0.7142 ± 1.69	0.8695 ± 2.35	17.86 ± 1.54
F6	18.43±2.46	1.17 ± 1.86	0.8333 ± 3.15	0.9375 ± 2.09	12.50 ± 2.37
F7	17.10 ± 1.17	1.10 ± 1.81	0.8823 ± 1.22	1.0714 ± 1.34	17.64 ± 1.34
F8	21.80 ± 0.32	1.02 ± 1.25	0.8823 ± 2.37	1.1538 ± 2.35	23.53 ± 2.5
F9	26.56 ± 2.67	0.98 ± 2.69	0.8823 ± 2.98	1.1538 ± 2.26	23.53 ± 2.6
F10	33.69 ± 2.87	0.96 ± 3.07	0.8823 ± 1.07	1.25 ± 1.93	29.41 ± 0.97
F11	15.52 ± 2.65	1.15 ± 1.54	0.8333 ± 2.88	0.9375 ± 2.85	11.11 ± 2.81
F12	18.43 ± 1.75	1.11 ± 2.33	0.8333 ± 1.14	1.0000 ± 1.69	16.67 ± 1.63
F13	23.19 ± 1.22	0.95 ± 1.4	0.8333 ± 2.76	1.0714 ± 2.05	22.22 ± 2.41
F14	24.77 ± 2.36	0.93 ± 2.04	0.8333 ± 2.01	1.1538 ± 1.28	27.78 ± 1.23
F15	26.56 ± 1.67	0.89 ± 1.57	0.8333 ± 2.99	1.1538 ± 1.07	27.78 ± 1.47

Table no 6: Diameter and thickness of floating tablets.

Formulation	Diameter (mm)	Thickness (mm)
F1	13.07±1.02	1.18±2.37
F2	13.08±2.95	1.45±1.14
F3	13.04±1.26	1.32±1.18
F4	13.06±0.68	1.25±2.05
F5	13.05±1.26	1.32±1.5
F6	13.11±2.67	1.19±0.69
F7	13.1±2.59	1.28±2.87
F8	13.06±3.05	1.22±1.94
F9	13.11±1.61	1.33±3.19
F10	13.14±1.27	1.30±1.60
F11	13.06±0.26	1.16±2.09
F12	13.04±1.53	1.17±2.3
F13	13.04±2.41	1.2±1.87
F14	13.02±3.81	1.3±2.90
F15	13.04±1.58	1.33±3.89

Table No. 7: Floating lag time of floating formulations

Batch	FLT
F1	15.5 ± 2.01
F2	9.7 ± 1.34
F3	6.65 ± 1.67
F4	5.2 ± 1.26
F5	3.41 ± 1.39
F6	10.2 ± 1.87
F7	6.1 ± 1.54
F8	5.00 ± 1.61
F9	4.3 ± 0.3
F10	3.58 ± 1.8
F11	7.76 ± 1.93
F12	5.33 ± 1.04
F13	4.58 ± 1.60
F14	3.9 ± 2.37
F15	3.51 ± 1.53

Table No. 8: Swelling characteristics of matrix tablets.

Batch	Initial Weight	Initial Thickness	Initial Diameter	Final Weight	Final Thickness	Final Diameter	Swelling Index
F1	252.53 ± 1.12	1.18 ± 0.02	13.07 ± 0.02	502.46 ± 5.36	3.26 ± 2.33	16.12 ± 3.52	98.73
F2	251.63 ± 2.00	1.45 ± 0.37	13.08 ± 1.06	537.36 ± 3.24	3.58 ± 3.11	16.35 ± 2.45	113.55
F3	252.53 ± 1.33	1.32 ± 0.01	13.04 ± 0.005	595.46 ± 4.36	3.42 ± 3.55	16.40 ± 0.92	135.80
F4	253.46 ± 1.08	1.25 ± 0.005	13.06 ± 0.01	611.47 ± 3.10	3.64 ± 0.91	16.39 ± 0.66	141.24
F5	251.06 ± 2.45	1.19 ± 0.02	13.05 ± 0.01	633.58 ± 3.66	3.26 ± 2.76	16.48 ± 1.63	152.36
F6	252.7 ± 2.71	1.19 ± 0.01	13.11 ± 0.02	575.7 ± 5.25	3.39 ± 1.63	16.43 ± 3.19	104.07
F7	251.66 ± 1.89	1.28 ± 0.04	13.10 ± 0.03	542.2 ± 3.44	3.15 ± 0.46	16.49 ± 2.65	115.44
F8	252.56 ± 2.11	1.22 ± 0.01	13.06 ± 0.005	565.1 ± 4.25	3.21 ± 1.11	16.62 ± 1.56	123.74
F9	253.6 ± 2.55	1.33 ± 0.02	13.11 ± 0.01	583.3 ± 3.96	3.75 ± 1.66	16.68 ± 2.04	130.00
F10	253.13 ± 1.24	1.30 ± 0.02	13.14 ± 0.005	597.66 ± 2.94	3.79 ± 1.23	16.71 ± 1.47	136.11
F11	253.3 ± 2.96	1.16 ± 0.03	13.06 ± 0.01	634.73 ± 3.05	4.12 ± 1.28	16.65 ± 1.03	150.58
F12	252.5	1.17	13.04	675.06	4.20	16.74	167.35

	± 1.34	± 0.02	± 0	± 4.16	± 1.36	± 1.64	
F13	252.26 ± 1.50	1.20 ± 0.02	13.04 ± 0.01	697.6 ± 5.64	4.29 ± 0.97	16.84 ± 1.09	176.54
F14	251.16 ± 2.31	1.30 ± 0.02	13.02 ± 0.005	725.9 ± 3.59	4.31 ± 1.24	17.04 ± 2.21	189.01
F15	252.03 ± 1.68	1.33 ± 0.015	13.04 ± 0.015	751.06 ± 4.96	4.37 ± 1.38	17.11 ± 3.03	198.00

Table No. 9: Average percentage drug release of matrix floating tablets (8.5mm diameter)

Sr.No.	2 hr	4 hr	6 hr	8 hr	9 hr
F1	45.999 ± 2.63	66.338 ± 3.40	86.559 ± 2.46	98.786 ± 6.32	102.576 ± 2.67
F2	33.17 ± 2.96	48.53 ± 2.11	63.816 ± 3.0	80.555 ± 2.16	84.157 ± 3.05
F3	19.979 ± 3.07	38.525 ± 2.19	57.34 ± 1.32	75.688 ± 2.10	82.817 ± 2.62
F4	28.756 ± 3.62	42.942 ± 3.32	56.313 ± 1.07	73.282 ± 0.88	79.281 ± 1.14
F5	15.015 ± 2.82	36.049 ± 2.99	52.189 ± 3.02	72.781 ± 3.97	78.094 ± 2.28
F6	27.251 ± 3.09	40.951 ± 2.34	71.38 ± 2.36	87.027 ± 2.26	90.426 ± 0.93
F7	17.382 ± 1.99	30.447 ± 2.54	63.259 ± 3.34	78.321 ± 2.55	83.281 ± 2.67

F8	12.643 ± 2.45	27.844 ± 2.90	49.792 ± 1.21	62.631 ± 2.78	70.583 ± 1.12
F9	16.811 ± 0.59	25.879 ± 1.60	44.152 ± 1.51	56.019 ± 2.25	63.487 ± 1.95
F10	14.325 ± 2.47	24.711 ± 1.45	39.905 ± 1.85	49.461 ± 1.18	54.523 ± 1.59
F11	22.953 ± 1.08	36.821 ± 1.71	57.795 ± 2.13	67.062 ± 2.03	70.934 ± 3.84
F12	22.646 ± 3.98	34.197 ± 2.67	51.76 ± 1.14	61.709 ± 2.24	65.387 ± 1.07
F13	25.339 ± 1.14	36.801 ± 2.34	44.323 ± 2.71	55.55 ± 3.83	65.618 ± 4.40
F14	20.58 ± 1.33	31.806 ± 2.10	43.422 ± 2.15	57.602 ± 2.97	62.062 ± 1.65
F15	17.243 ± 1.60	29.49 ± 1.84	44.912 ± 1.15	52.938 ± 1.72	61.47 ± 2.64

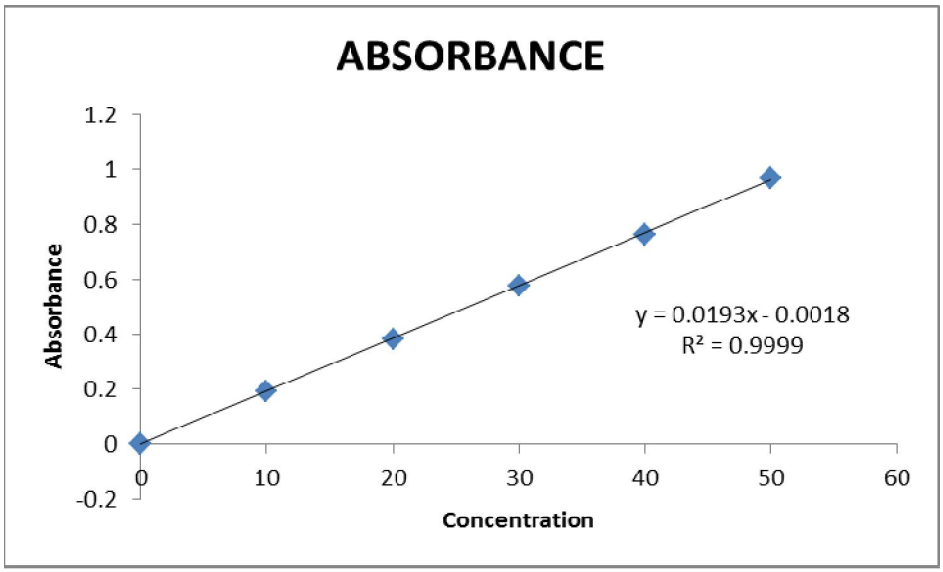

Figure No.1: Calibration curve of Rosiglitazone maleate

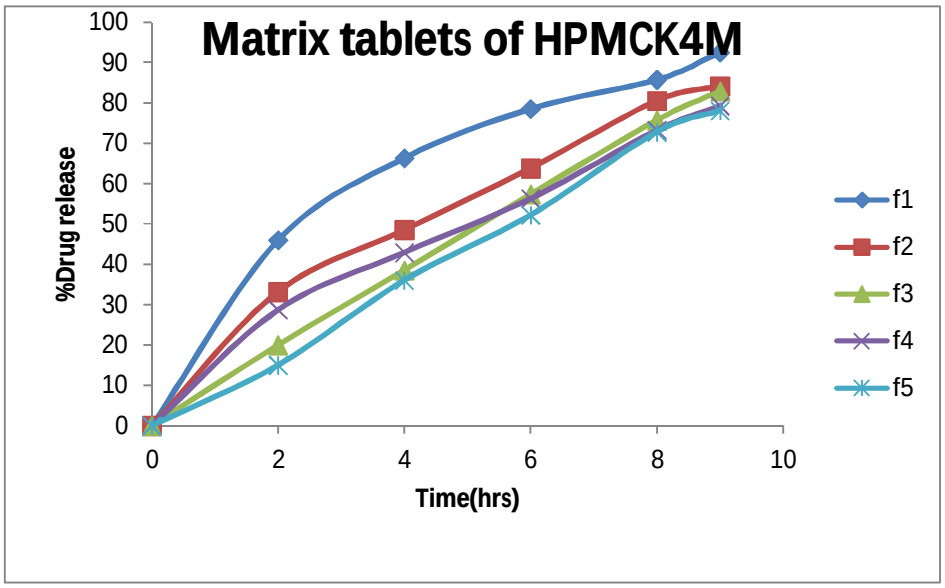

Figure No. 2: Drug release from matrix units F1-F5

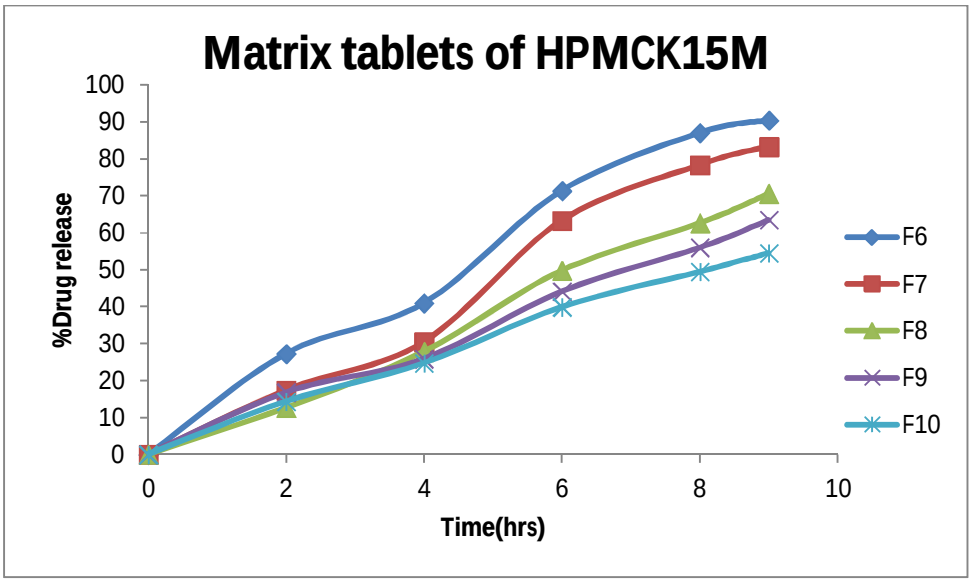

Figure No. 3: Drug release from matrix units F6-F10

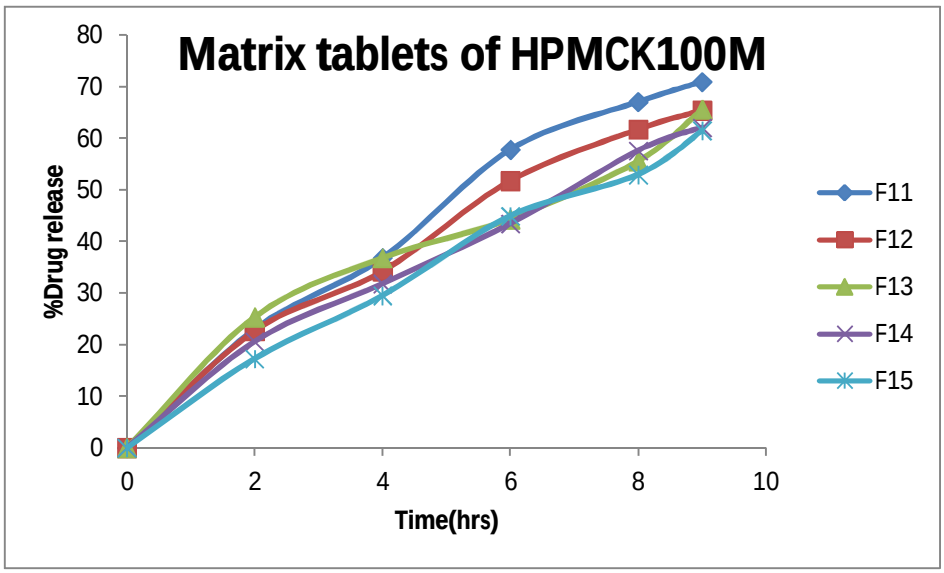

Figure No. 4: Drug release from matrix units F11-F15

Effect of types of polymer on release rate from matrix floating tablets (8.5 mm Diameter)

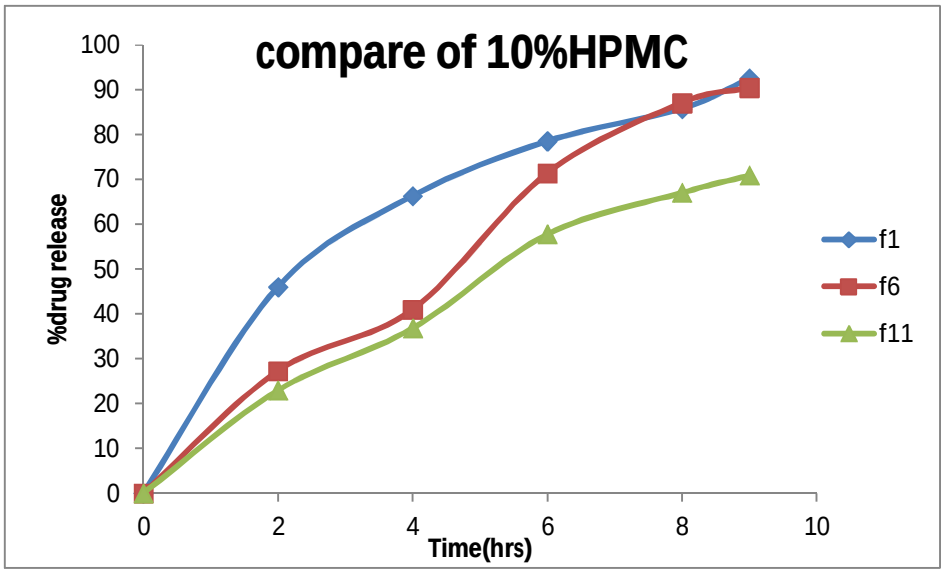

Figure No.5: Drug release profiles from matrix floating units

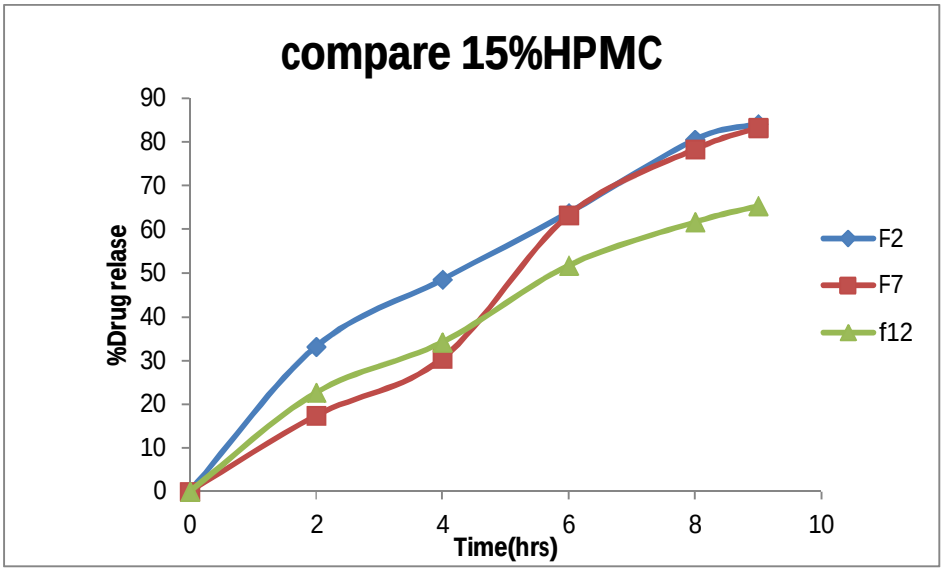

Figure No.6: Drug release profiles from matrix floating units

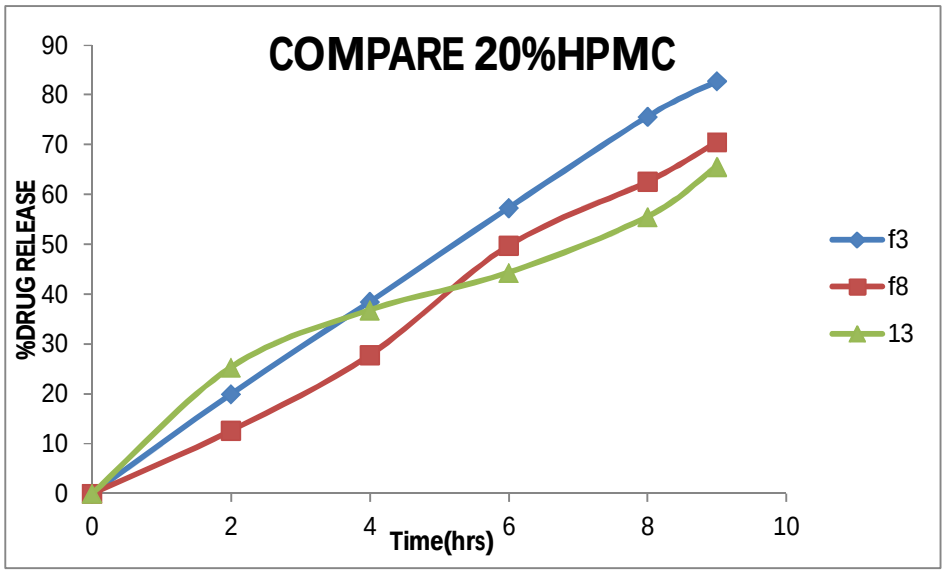

Figure No.7: Drug release profiles from matrix floating units

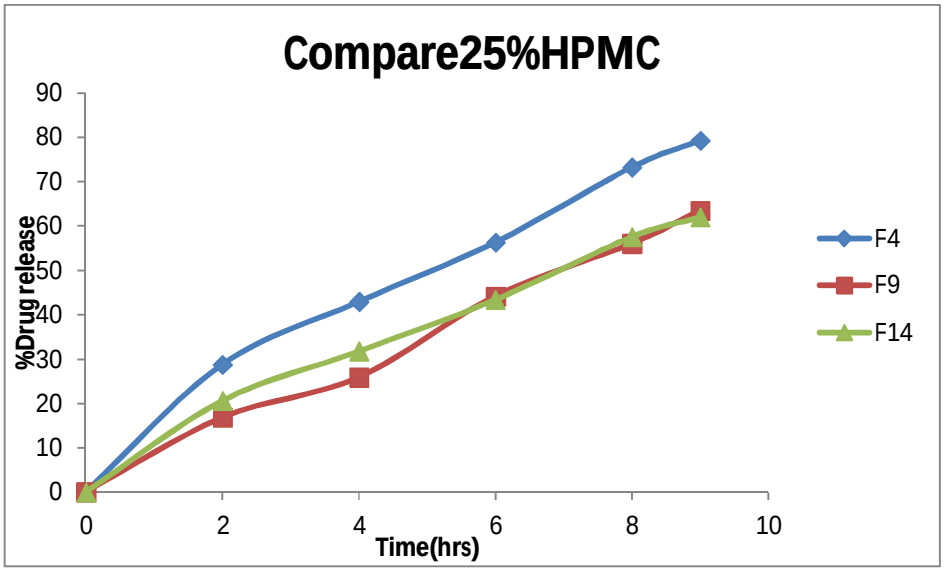

Figure No.8: Drug release profiles from matrix floating units

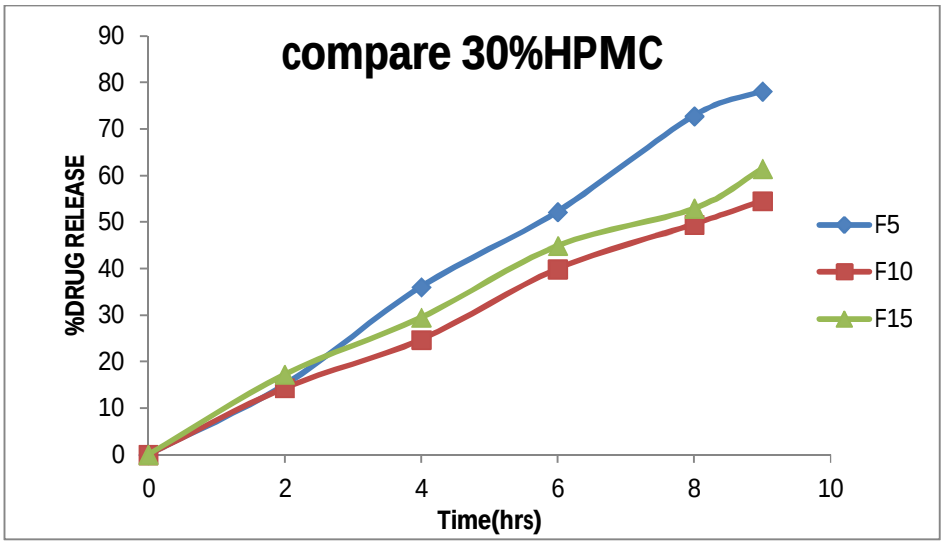

Figure No.9: Drug release profiles from matrix floating units

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