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FORMULATION AND EVALUATION OF SUSTAINED RELEASE MATRIX TABLETS OF VALSARTAN

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ABSTRACT

The main aim of present work was to formulate and evaluate sustain release matrix tablets of Valsartan, an angiotensin II Receptor type 1 antagonist. Sustain release formulation are those which delivers the drug locally or systemically at a predetermined rate for a fixed period of time. The powder mixtures were subjected to various pre-compression parameters such as angle of repose, bulk density, tapped density and Carr's index shows satisfactory result and the compressed tablets are evaluated for post-compression parameters such as weight variation, thickness, hardness, friability, drug content, *in-vitro* dissolution and stability studies. *In-vitro* dissolution studies were carried out for 24 hours using 0.1 N HCL for first 2 hours and pH 6.8 phosphate buffer for 24 hours and the result showed that formulations F_4 and F_7 showed good dissolution profile to control the drug release respectively. Formulation containing higher concentration of chitosan and sodium alginate along with polymers sustained the drug release for the period of 24 hours. The compatibility of the drug, polymers and other excipients were determined by FT-IR Spectroscopy. Results showed that the drug was compatible with polymers and other excipients. The release data was fitted to various mathematical models such as Zero-order, First-order, Higuchi equation and Korsmeyer-Peppas model to evaluate the kinetics and the drug release. The stability studies were carried out for 3 months and result indicates that the selected formulations (F_4 and F_7) were stable.

KEY WORDS: Carbopol 934P, Chitosan, sodium alginate, sustain release matrix tablet, Valsartan.

1. INTRODUCTION

Oral delivery of drugs is the most preferable route of drug delivery due to the ease of administration, patient compliance and flexibility in formulation, etc. Many of the drug delivery systems available in the market are oral drug delivery type systems.[1] Approximately 50% of the drug delivery systems available in the market are oral drug delivery systems and historically too, oral drug administration has been the predominant route for drug delivery. It does not pose the sterility problem and minimal risk of damage at the site of administration.[2] Pharmaceutical products designed for oral delivery are mainly immediate release type or conventional drug delivery systems, which are designed for immediate release of drug for rapid absorption. These immediate release dosage forms have some limitations such as:

1) Drugs with short half-life require frequent administration, which increases chances of missing dose of drug leading to poor patient compliance.
2) A typical peak-valley plasma concentration-time profile is obtained which makes attainment of steady state condition difficult.
3) The fluctuating drug levels may lead to precipitation of adverse effects especially of a drug with small therapeutic index, whenever overmedication occurs.

In order to overcome the drawbacks of conventional drug delivery systems, several technical advancements have led to the development of controlled drug delivery system that could revolutionize method of medication and provide a number of therapeutic benefits.[3]

Design and formulation of oral sustained release drug delivery system[4,5]

The oral route of administration is the most preferred route due to flexibility in dosage form, design and patient compliance. But here one has to take into consideration, the various pH that the dosage form would encounter during its transit, the gastrointestinal motility, the enzyme system and its influence on the drug and the dosage form. The majority of oral sustained release systems rely on dissolution, diffusion or a combination of both mechanisms, to generate slow release of drug to the gastrointestinal tract. Theoretically and desirably a sustained release delivery device, should release the drug by a zero-order process which would result in a blood-level time profile similar to that after intravenous constant rate infusion. Plasma drug concentration-profiles for conventional tablet or capsule formulation, a sustained release formulation, and a zero order sustained release formulation.

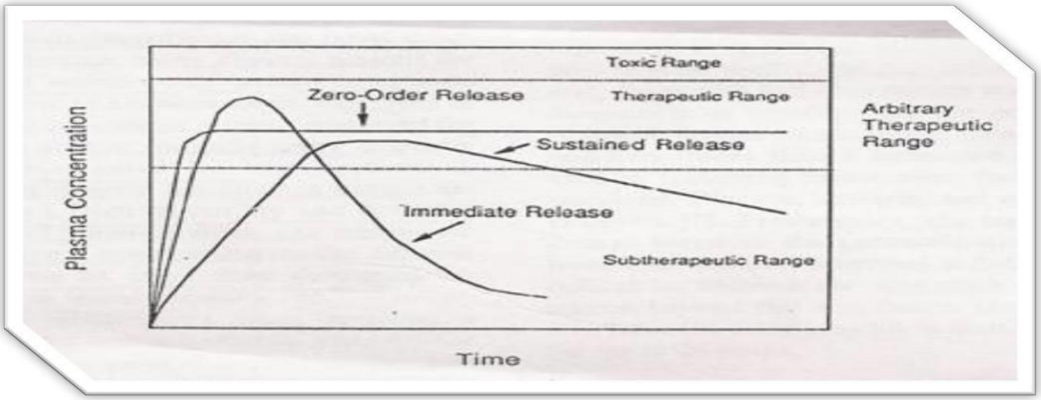

Fig 1: Plasma Concentration-profiles Vs Time (sustained release formulation and zero order formulation)

Sustained release constitutes any dosage form that provides medication over an extended time or denotes that the system is able to provide some actual therapeutic control whether this is of a temporal nature, spatial nature or both. Sustained release system generally do not attain zero order type release and usually try to mimic zero order release by providing drug in a slow first order. Repeat action tablet are an alternative method of sustained release in which multiple doses of drug are an alternative method of sustained release, in which, multiple doses are contained within a dosage form and each dose is released at a periodic interval.

Delayed release system, in contrast, may not be sustaining, since often the function of these dosage forms is to maintain the drug in the dosage for some time before release, for example. Enteric coated tablet. A sustained release dosage form will provide a therapeutic concentration of the drug in the blood that is maintained throughout the dosing interval with a reduction in a peak concentration ratio.

Advantages Of Sustain Release Dosage Forms

1. Reduction in frequency of intakes.
2. Reduce side effects.
3. Uniform release of drug over time.
4. Better patient compliance.

Disadvantages Of Sustained Release Drug Delivery

1. Increased cost.
2. Toxicity due to dose dumping.
3. Unpredictable and often poor *in vitro-in vivo* correlation.

4. Risk of side effects or toxicity upon fast release of contained drug (mechanical failure, chewing or masticating, alcohol intake).
5. Increased potential for first- pass clearance.
6. Need for additional patient education and counseling.[6]

Mechanism of drug release from the matrix tablets

Drug in the outside layer exposed to the bathing solution is dissolved first and then diffuses out of the matrix. This process continues with the interface between the bathing solution and the solid drug moving toward the interior. It follows that for this system to be diffusion controlled, the rate of dissolution of drug particles within the matrix must be much faster than the diffusion rate of dissolved drug leaving the matrix.

Derivation of the mathematical model to describe this system involves the following assumptions:

1) A pseudo-steady state is maintained during drug release.
2) The diameter of the drug particles is less than the average distance of drug diffusion through the matrix.
3) The bathing solution provides sink conditions at all times.

2. MATERILS AND METHODS

Standard gift sample of Valsartan was provided by Yarrow Chem. Products, Mumbai. Carbapol 934P, Chitosan, Sodium Alginate, Polyvinyl Pyrrolidone K30, Micocrystaline Cellulose, Magneshium Stearate and Talc are procured by S.D Fine Chem. Ltd., Mumbai.

Pre-Formulation Studies

Preformulation testing is the first step in the rational development of dosage forms of a drug substance. It can be defined as an investigation of physical and chemical properties of a drug substance alone and when combined with excipients. The overall objective of pre-formulation testing is to generate information useful to the formulator in developing stable and bioavailable dosage forms which can be mass produced.

Analytical Method used in the Determination of Valsartan

The UV spectrophotometric method was developed for the analysis of the drug using Shimadzu 1800 spectrophotometer.

Preparation of 6.8 pH phosphate buffer solution

A) Preparation of 0.2 M potassium dihydrogen phosphate

27.22gm of potassium dihydrogen phosphate was weighed and diluted up to 1000 ml with distilled water to get 0.2M potassium dihydrogen phosphate.

B) Preparation of 0.2 M NaOH

8 gm Sodium hydroxide was weighed and diluted up to 1000 ml with distilled water to get 0.2M sodium hydroxide solution.

Preparation of 6.8 pH phosphate buffer solution

50 ml of the 0.2M potassium dihydrogen phosphate solution was taken from the stock solution in a 200 ml volumetric flask and 22.4 ml of sodium hydroxide solution from stock solution of 0.2M sodium hydroxide solution was added and then distilled water was used to make up the volume.

3. RESULTS AND DISCUSSION

Determination of λ_{max} of Valsartan

The λ_{max} of the Valsartan was found to be 249 nm in 0.1 N NaOH.

Calibration curve of Valsartan

The absorbance of Valsartan was measured in a UV spectrophotometer at 249 nm against 0.1 N NaOH as blank. The absorbance so obtained was tabulated (Table no.1) and graph was obtained by plotting absorbance Vs concentration (Figure no.2).

Table no.1: Spectrophotometric data for the estimation of Valsartan in 0.1 N NaOH.

SL. No.	Concentration (µg/ml)		Absorbance at 249 nm			
		Trail-1	Trail-2	Trail-3	Average	S.D.
1	0	0	0	0	0	0
2	5	0.0125	0.0153	0.0153	0.00952	0.00306
3	10	0.0222	0.022	0.0219	0.0189	0.0088
4	15	0.0259	0.0258	0.0258	0.0258	0.00077
5	20	0.0320	0.0331	0.0329	0.0360	0.00351
6	25	0.0369	0.0376	0.0378	0.04174	0.00422
7	30	0.0432	0.0433	0.0434	0.0533	0.00412

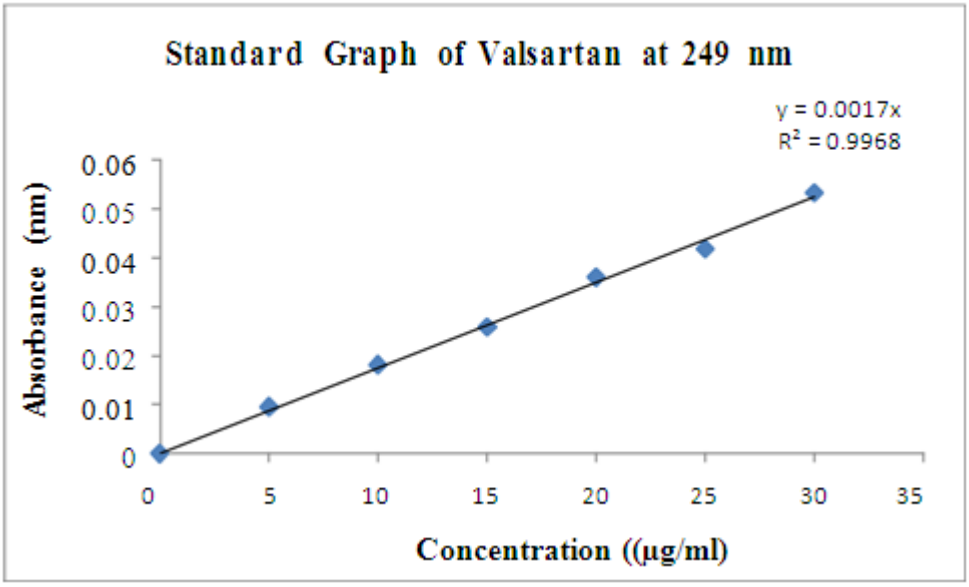

Figure 2: Calibration Curve of Valsartan in 0.1 N NaOH.

Compatibility studies using FT-IR

Infra-red spectrum of drug, polymers and mixture of both were determined by KBr disks method. Samples were prepared in KBr disks by means of a hydrostatic press at 5 tons pressure for 5 min and obtained spectra were shown in the figure no: 3-6**.** All the characteristic peaks of Valsartan were present in the spectrum of drug and polymer mixture, indicating compatibility between drug and polymer. From the results, it was concluded that there was no interference of the functional group as the principle peaks of the Valsartan were found to be unaltered in the drug- polymer physical mixtures, indicating that they were compatible chemically. The spectrum confirmed that there is no significant change in the chemical integrity of the drug.

Table 2: Interpretations of IR-spectrum.

	Functional groups with wave number (cm^{-1})				
Ingredients					
	N-H (s)	**N-O (b)**	**C-H(b)**	**C-O(s)**	**O-H (b)**
Valsartan	1651.12	1558.54	1427.37	1280.78	840.99
Valsartan + Chitosan	--	1550.82	1388.79	1273.06	895.00
Valsartan + sodium alginate	1643.41	1550.82	1396.56	1273.06	856.42
Valsartan + Carbapol	--	1550.82	1396.51	1273.06	856.42
Valsartan + Physical mixtures	1705	1550.82	1388.79	1273.06	864.14

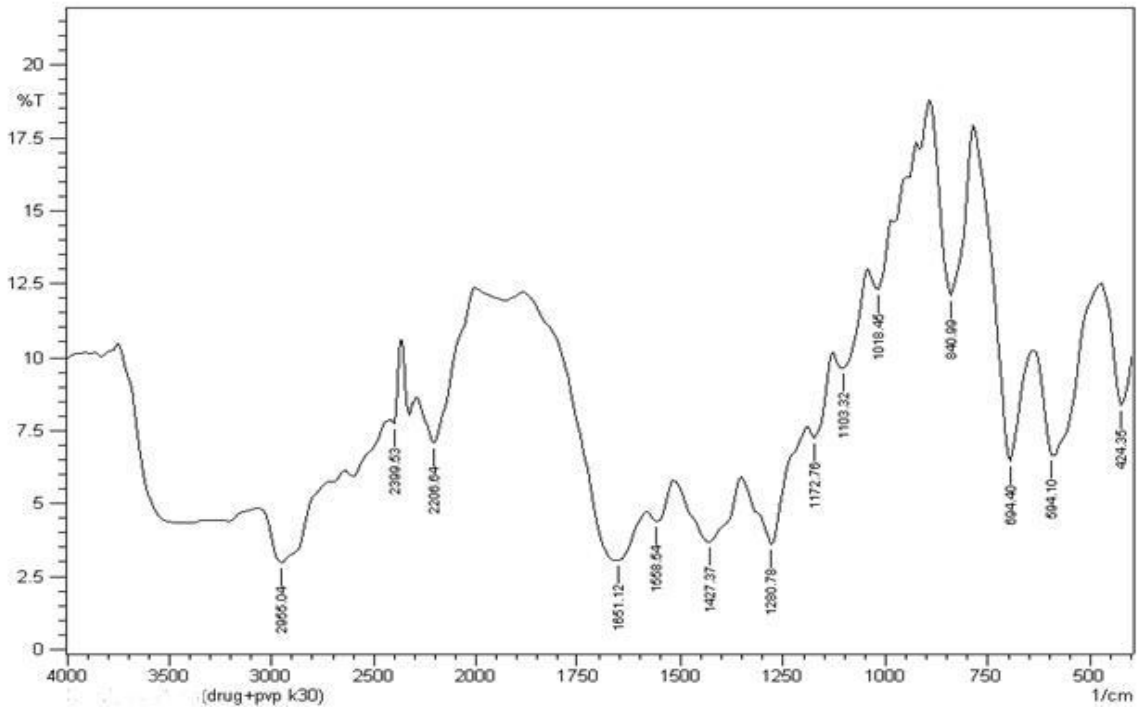

Figure 3: IR Spectrum of Pure Drug Valsartan.

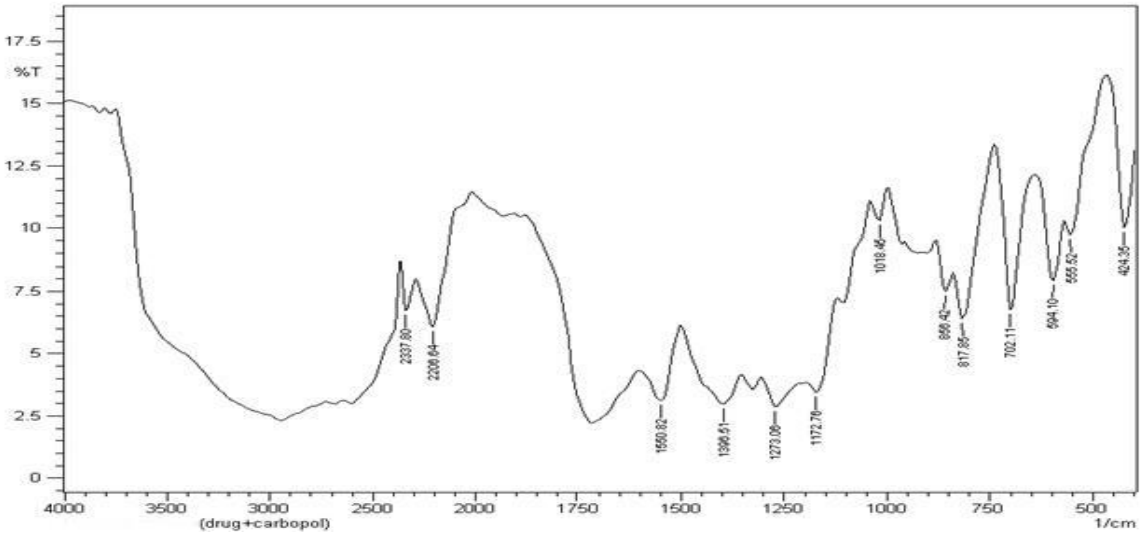

Figure 4: IR Spectrum of carbopol.

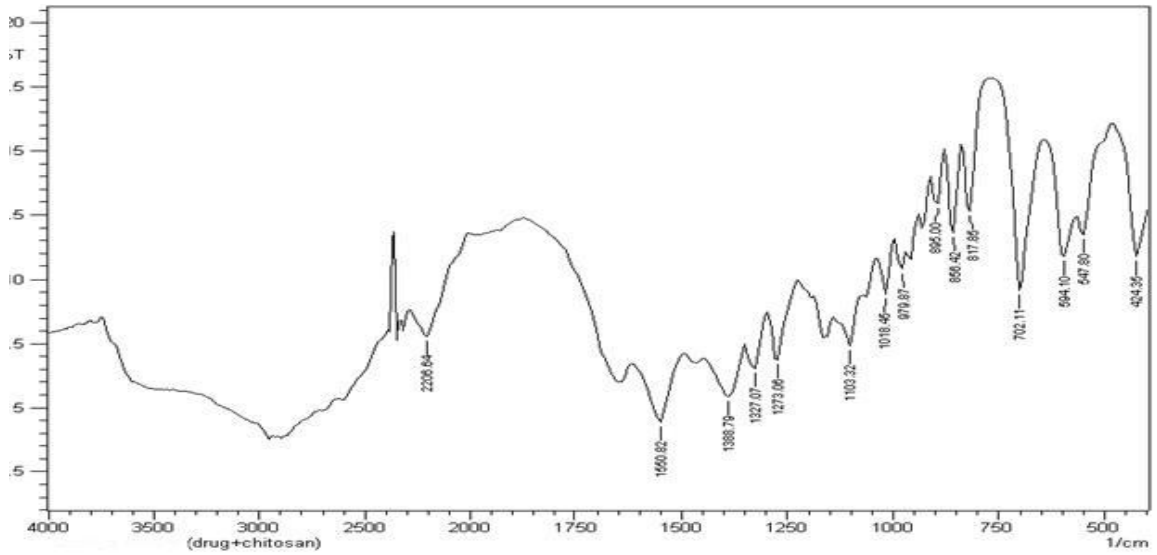

Figure 5: IR Spectrum of Chitosan.

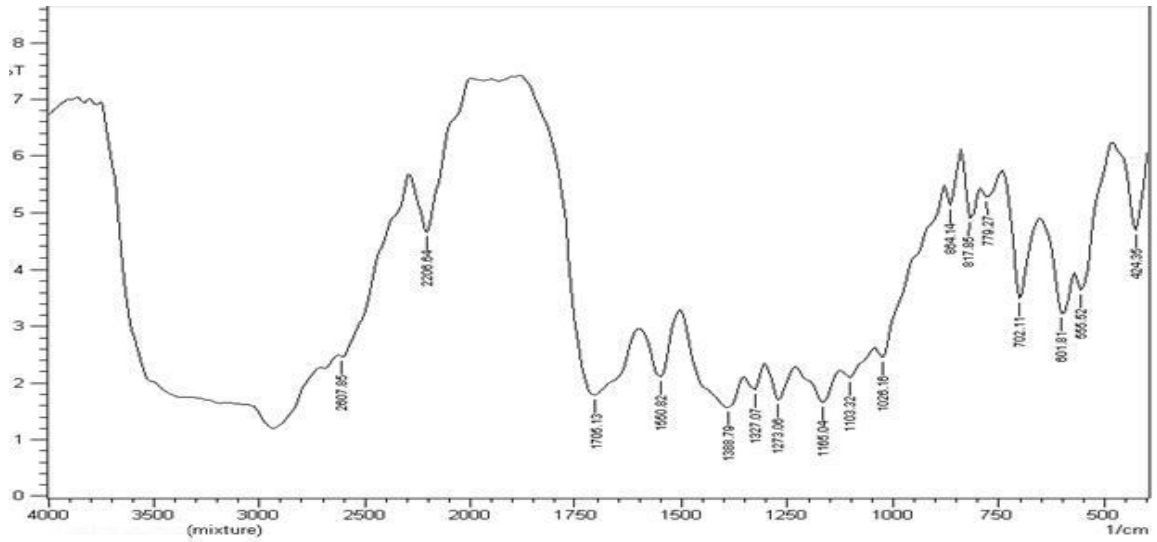

Figure 6: IR Spectrum of Drug + Physical mixtures.

Formulation Design

The main aim of present study was to formulate sustain release matrix tablets of Valsartan using chitosan in order to improve its therapeutic efficacy and decrease the adverse effects by minimizing the dosing frequency. In this case nine formulations of sustain released matrix tablets were prepared by using different polymers such as Chitosan, Sodium alginate, Carbapol, MCC and PVP K_{30} in different ratios. The powder mixture was subjected to pre-compression and post-compression evaluation before and after compression.

Evaluation Parameters

Evaluation of powder blended characteristics of matrix tablet formulation of Valsartan

For each type of formulation, blends of Valsartan and other excipients were prepared and evaluated for various parameters such as bulk density, tapped density, Carr's compressibility index, Hausner's ratio and angle of repose. Bulk density was found in the range of 0.355-0.3850 g/cm^3 and the tapped density between 0.4101- 0.4880g/cm^3 indicating both parameters were found to be within the limits. Using the above two density data, Carr's compressibility index were calculated. The compressibility index and Hausner's ratio was found in the range of 7.27-18.42% and 1.053-1.24 respectively indicating that all powder blends showed excellent to acceptable flow properties. The flow property of all powder blends was better explained from angle of repose. The angle of repose was found in the range of 25.33-31.43°. The results of angle of repose showed all powder blends exhibited good to acceptable flow property. The results of pre-compression parameters are shown in table no 3.

Table No. 3: Evaluation parameters of pre-formulation characteristics of powder blend.

Formulations Number	Bulk Density (gm/cc)	Tapped Density (gm/cc)	Carr's Index (%)	Hausner's Ratio	Angle of Repose (θ)
F1	0.3716±0.0011	0.4101±0.0025	7.27±0.659	1.177±0.0076	29.73±0.41
F2	0.3803±0.0005	0.4120±0.0026	7.58±0.514	1.053± 0.0060	25.33±0.63
F3	0.3843±0.0015	0.4120±0.005	7.43±0.760	1.059±0.0088	28.44±0.35
F4	0.376±0.0020	0.4270±0.0037	13.78±0.386	1.073±0.0053	27.48±0.52
F5	0.355±0.0017	0.4600±0.0024	17.31±0.794	1.224±0.011	31.34±0.13
F6	0.3810±0.0045	0.4880±0.0065	18.42±0.120	1.24±0.0020	28.26±0.43
F7	0.3850±0.0081	0.4384±0.133	10.88±0.030	1.123±0.0021	27.27±0.42

Physical evaluation of tablets

After compression various quality control tests were carried out, which demonstrated following organoleptic properties *viz*. colour, odour and shape. All formulations **(F1 to F7)** were found to be white in colour, odourless and concave round flat with break-line on one side.

Table No. 4: Organoleptic properties of prepared tablets.

Formulation Code	Color	Odour	Shape
F1	White color	Odourless	Concave, round and flat with break-line on one side
F2	White color	Odourless	Concave, round and flat with break-line on one side
F3	White color	Odourless	Concave, round and flat with break-line on one side
F4	White color	Odourless	Concave, round and flat with break-line on one side
F5	White color	Odourless	Concave, round and flat with break-line on one side
F6	White color	Odourless	Concave, round and flat with break-line on one side
F7	White color	Odourless	Concave, round and flat with break-line on one side

Table No. 5: Post-compression parameters results.

Formulation	Diameter (mm)± SD	Thickness (mm)± SD	Weight variation (mg)	Hardness (kg/cm^2)	Friability (%)	Drug content (%)
F1	7.82±0.012	3.9±0.09	250.89±0.12	7.3±0.04	0.61±0.007	98.25±0.044
F2	7.80±0.002	4.0±0.02	253.88±0.60	7.8±0.03	0.52±0.005	100.31±0.037
F3	7.85±0.007	4.2±0.01	251.12±0.52	8.0±0.07	0.58±0.031	98.54±0.07
F4	7.84±0.022	3.9±0.07	249.81±0.13	6.5±0.04	0.72±0.016	99.67±0.087
F5	8.0±0.015	4.0±0.04	250.80±0.32	6.8±0.08	0.665±0.09	99.37±0.058
F6	7.94±0.010	3.8±0.09	248.92±0.44	7.1±0.03	0.714±0.01	98.97±0.073
F7	7.97±0.016	4.1±0.01	252.61±0.60	6.0±0.05	0.447±0.00	101.61±0.08

***In-vitro* drug release study**

In this study carbopol was chosen as polymer and it was combined with chitosan and sodium alginate to explore their sustain release capability. The *in-vitro* release data for chitosan-carbopol and sodium alginate-carbopol based Valsartan sustain released matrix tablets are represented in table 6 and illustrated in figure 7. The *in-vitro* release of Valsartan, from prepared matrix tablets formulations was mainly affected by dissolution medium, concentration of chitosan, concentration of sodium alginate and concentration of polymers. *The in-vitro* release of Valsartan form prepared matrix tablets also depends on swelling behaviour of the tablets, higher the tablet swells comparative the lesser amount of drug release. The *in-vitro* release study was performed in 0.1 N HCl for initial first 2 hrs, and then the medium was replaced by phosphate buffer pH 6.8) and study was continued for 24 hour. The *in-vitro* release of Valsartan was higher in first 6-7 hours in all formulations. After 1 hour, approximately 10.29%- 18.34% of Valsartan from chitosan-carbapol tablets, 16.90%-21.91% from sodium alginate-carbapol, 25.12% from tablets containing only release retardant polymer has been released. Initially amount of drug release was higher but after 6-7 hrs drug release was retarded. Formulation F_1 do not contains any crosslinking agent, so almost all drugs was released at the end of 12 hrs. Formulation F_2, F_3, F_5, and F_7 containing lower concentration of chitosan and sodium alginate showed almost all drug release within 16 hrs, 20 hrs, 16 hrs and 18 hrs respectively. Thus these formulations were not considered as good formulation as the maximum amount of drug was released before desire period of time i.e. 24 hrs. The ionic interaction between crosslinking agents and negatively charged polymers was greatly reduced at this pH 6.8 and forms a loose network with increase porous surface which allows great part of dissolution media. Formulation F_4 and F_7 containing highest concentration of chitosan and sodium alginate respectively along with carbopol gum respectively prolong the release of Valsartan to 24 hrs which might be due to the fact that the self-assembled poly electrolyte complexes film was formed on the surface of cross linking

agent-polymer based system. Swelling study also showed that formulation which contains higher concentration of cross linking agent showed higher swelling capacity and prolonged the drug release to 24 hrs.

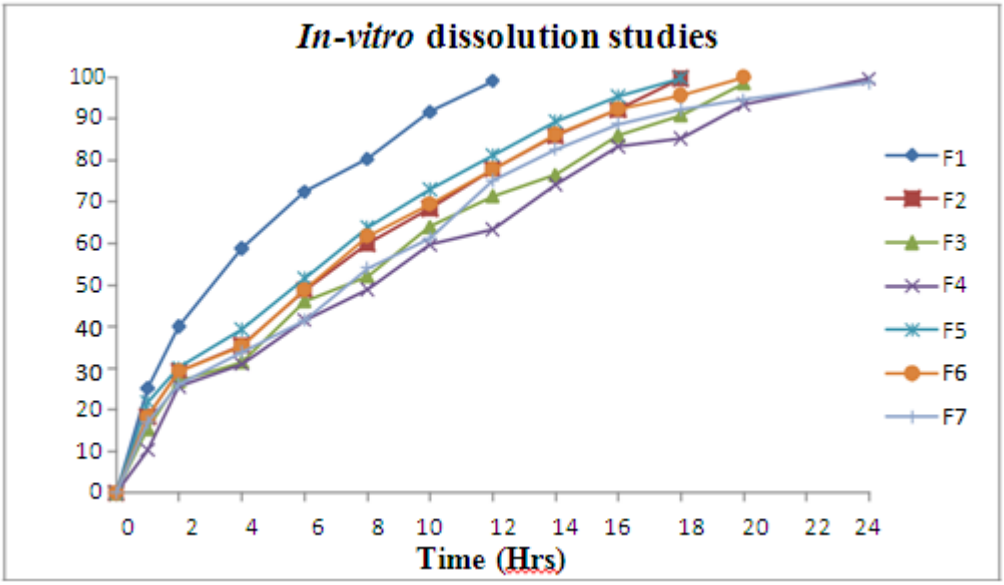

Figure 7: Comparative dissolution profile of the formulations F_1 to F_7

Table 6: *In-vitro* drug release profile of Valsartan S.R.M Tablets.

Time (Hrs)			Cumulative Percentage Drug Release				
	F_1	F_2	F_3	F_4	F_5	F_6	F_7
0	0	0	0	0	0	0	0
1	25.12±0.09	18.34±0.43	15.386±0.33	10.29±0.55	21.91±0.54	18.25±0.32	16.90±0.85
2	40.02±0.12	29.24±0.21	26.905±0.45	25.64±0.62	30.92±0.43	29.25±0.22	25.99±0.42
4	58.82±0.14	35.45±0.33	31.465±0.21	30.94±0.53	39.33±0.54	35.20±0.64	33.71±0.79
6	72.41±0.14	48.71±0.2	46.137±0.13	41.54±0.45	51.64±0.51	48.82±0.73	41.55±0.54
8	80.03±0.28	59.99±0.54	52.186±0.43	48.96±0.38	63.93±0.65	61.73±0.85	54.08±0.64
10	91.61±0.34	68.41±0.55	63.97±0.42	59.68±0.42	72.96±0.72	69.40±0.88	61.27±0.53
12	99.07±0.12	77.09±0.22	71.33±0.54	63.38±0.38	81.23±0.42	77.73±0.95	75.14±0.43
14	--	85.86±0.26	76.50±0.65	74.11±0.43	89.37±0.45	86.24±0.76	82.67±0.48
16	--	92.15±0.33	85.96±0.66	83.39±0.14	95.39±0.62	92.28±0.87	88.75±0.48
18	--	99.71±0.42	90.88±0.59	85.21±0.11	99.77±0.11	95.62±0.73	92.23±0.48
20	--	--	98.54±0.43	93.39±0.14	--	99.99±0.61	94.54±0.48
24	--	--	--	99.54±0.11	--	--	98.78±0.48

Release kinetic studies

The *in-vitro* drug release data of all formulations were analysed for determining kinetics of drug release. The obtained data were fitted to zero order kinetics, first order kinetics and Higuchi model. The highest correlation coefficient (r^2) obtained from these method gives an idea about model best fitted to the release data. From the results of kinetic studies, the

examination of correlation coefficient "r" indicated that the drug release followed first order release kinetics. It was found that the value of "r" for first order ranged from 0.981-0.992, which is near to 1 when compared to Higuchi square root ranged from 0.892-0.958 and zero order ranged from 0.895-0.969. So, it was understood to be following first order release pattern followed by all formulations. Further, to understand the drug release mechanism, the data were fitted into Korsmeyer Peppas exponential model $M_t / M_a = Kt^n$. Where M_t / M_a is the fraction of drug released after time 't' and 'k' is kinetic constant and 'n' release exponent which characterizes the drug transport mechanism. The release exponent (n) ranges in between 0.483-0.7911. For all the formulations F_1 to F_9 the values for 'n' ranged above 0.89 which indicates that all the formulations followed non-fickian release mechanism. The relative complexity of the prepared formulations may indicate that the drug release mechanism was possibly controlled by the combination of diffusion and erosion.

Table no. 7: Release exponent values and release rate constant values for different formulations.

Batch	Zero Order	First Order	Higuchi's Plots	Korsmeyer-Peppas plots		Best fit Model	Drug release Mechanism
	R^2	R^2	R^2	R^2	N		
F_1	0.9293	0.982	0.9116	0.912	0.597	First order	Non-Fickian
F_2	0.969	0.974	0.8944	0.915	0.594	First order	Non-Fickian
F_3	0.916	0.984	0.9217	0.899	0.6077	First order	Non-Fickian
F_4	0.946	0.978	0.8926	0.892	0.577	First order	Non-Fickian
F_5	0.944	0.992	0.9581	0.902	0.488	First order	Non-Fickian
F_6	0.895	0.958	0.9022	0.929	0.7911	First order	Non-Fickian
F_7	0.896	0.981	0.9258	0.938	0.4838	First order	Non-Fickian

Stability studies

Based on the results of *in-vitro* drug release two best formulations F_4 and F_7 were selected for three month stability studies at 25ºC/60% RH and at 45ºC/75% RH. The stability studies were conducted according to the method described in section four. The selected formulations were evaluated for physical appearance, hardness, friability, and drug content and *in-vitro* drug release. The results showed that there was no significant change in physical appearance, hardness, friability, drug content and drug release profile throughout the study period. Three months of stability studies revealed that; there was no any significant degradation of the drug. Thus prepared formulations were physically and chemically stable. The result of stability studies were tabulated in Table No. 8.

Table 8: Results of stability studies for formulation F_4 stored at 25ºC/60% and 45ºC/75% RH.

Storage Period	Hardness Kg/cm^2	Stored at 25ºC/60% RH Formulation F_4			Stored at 40ºC/75% RH Formulation F_4			
		% friability	% Drug Content	% CDR	Hardness Kg/cm^2	% friability	% Drug content	% CDR
Initial	8.0±0.07	0.58±0.1	99.67±0.3	99.5±0.4	8.0±0.07	0.58±0.2	99.6±0.3	99.5±0.2
After 1 Month	7.9±0.12	0.60±0.3	98.84±0.1	99.2±0.4	7.7±0.098	0.61±0.1	98.7±0.2	99.0±0.3
After 2 Month	7.8±0.46	0.65±0.2	97.97±0.2	98.6±0.4	7.5±0.07	0.64±0.3	97.4±0.3	98.3±0.2
After 3 Month	7.6±0.13	0.62±0.1	97.76±0.3	98.0±0.4	7.4±0.07	0.66±0.1	97.1±0.3	97.8±0.2

Table 9: Results of stability studies for formulation F_7 stored at 25ºC/60% and 45ºC/75% RH.

Storage Period	Hardness Kg/cm^2	Stored at 25ºC/60% RH Formulation F_7			Stored at 40ºC/75% RH Formulation F_7			
		% friability	% Drug content	% CDR	Hardness Kg/cm^2	% friability	Drug content	% CDR
Initial	6.6±0.06	0.54±0.2	101.6±0.3	98.6±0.5	6.6±0.09	0.54±0.3	96.8±0.3	98.7±0.5
After 1 Month	6.5±0.16	0.57±0.3	99.6±0.1	98.5±0.5	6.4±0.11	0.55±0.1	96.5±0.3	98.5±0.5
After 2 Month	6.3±0.21	0.60±0.4	99.4±0.2	98.1±0.5	6.2±0.21	0.59±0.1	96.2±0.3	97.8±0.2
After 3 Month	6.2±0.15	0.62±0.3	98.3±0.6	97.6±0.5	6.0±0.23	0.61±0.3	96.0±0.3	97.4±0.3

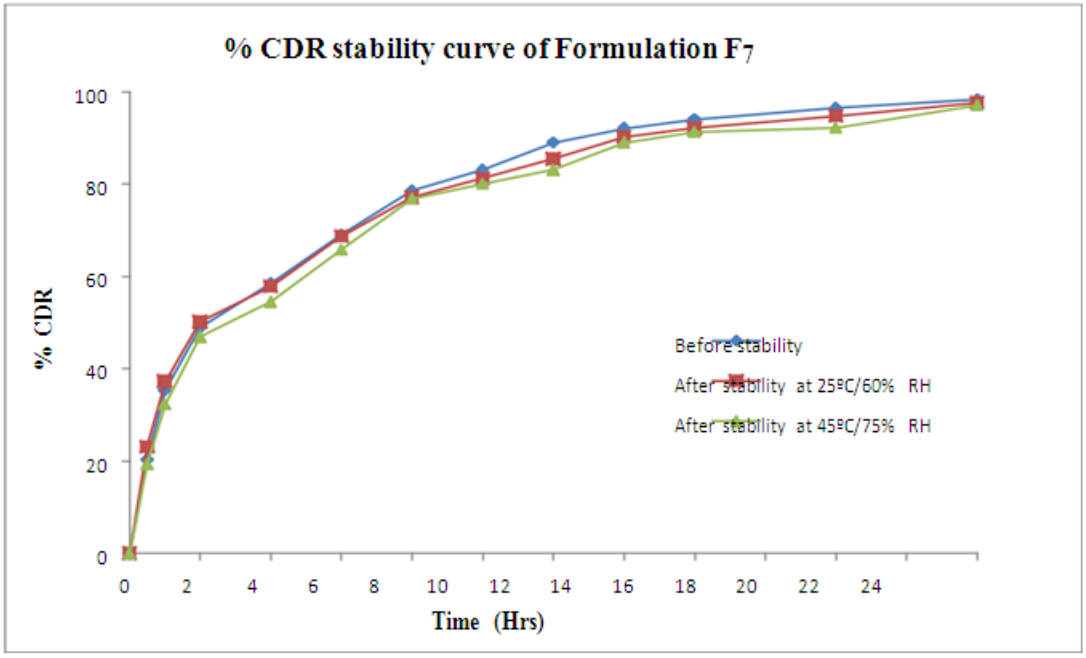

Figure 8: Dissolution rate profile of formulation F_7 before and after stability.

4. CONCLUSION

Valsartan is a potent, orally active non peptide tetrazole derivative and selectively inhibits Angiotensin II Receptor type 1 which causes reduction in blood pressure and is used in

treatment of hypertension. The objective of the present study was to investigate the possibility of sustaining the valsartan release from matrix tablet prepared by using different concentration of cross linking agents and polymers.

The following conclusions can be drawn from the result obtained.

- The pre-formulation studies like angle of repose, bulk density, tapped density Haunser's ratio and Carr's index of all formulations were found to be within the standard limits.
- FTIR studies revealed that there was no chemical interaction between drug and other excipients.
- The powder mixtures were compressed into tablet and evaluated for post-compression parameters like weight variation, thickness, hardness, friability and drug content. All the formulation batches showed acceptable results.
- The *in-vitro* drug release was studied with USP Type-II dissolution apparatus in both simulated gastric fluid and intestine fluid for a period of 24 hours. Results showed that formulations containing higher concentration of chitosan i.e. F_4 (99.54%) and sodium alginate i.e. F_7 (98.78%) sustained the drug release over a period of 24 hours.
- The *in-vitro* drug release follows first order and indicated that non-Fickian could be the mechanism of drug release.
- Stability studies showed that the tablets formulations were stable throughout the stability period.
- It was concluded that the polymer and cross linking agents plays a major role in the formulation of sustain release matrix tablets of Valsartan. Finally, the study revealed that the release of drug was low when the matrix tablet contained higher concentration of cross linking agents and polymers also showed similar diffusion and erosion kinetics.

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6. REFERENCES

1. Ravi Y, Najmuddin M and Dewalkar HV. Development and Evaluation of Theophylline Microballoons Drug Delivery System. Int Res J Pharm, 2012; 3(5): 241-245.
2. Kumar S, Kumar A, Gupta V, Malodia K and Rakha P. Oral Extended Release Drug Delivery System: A Promising Approach. Asian J Pharm Tech., 2012; 2(2): 38-43.

3. Rathore AS, Jat RC, Sharma N and Tiwari R. An Overview: Matrix Tablet as Controlled Drug Delivery System. Int J Res and Development in Pharm and Life Sci., 2013; 2(4): 482-492.
4. Chugh I, Seth N and Rana A.C. Oral sustained release drug delivery system. Int Res J Pharmacy, 2012; 3(5): 57-62.
5. Vinay K, S K Prajapati, Girish C, S, Mahendra S and Neeraj k. Sustained release matrix type drug delivery system. IRJP, 2012; 1(3): 934-60.
6. Parashar T, Soniya, Singh V, Singh G, Tyagi S, Patel C and Gupta A. Novel Oral Sustained Release Technology: A Concise Review. Int J Res & Development in Pharm and Life Sci., 2013; 2(2): 262-269.
7. Hemnani M, Patel U, Patel G, Daslaniya D, Shah A and Bhimani B. Matrix Tablets: A Tool of Controlled Drug Delivery. American J Pharm Tech Res., 2011; 1(4): 127-143.
8. Ankit B, Rathore RPS, Tanwar YS, Gupta S and Bhaduka G. Oral Sustained Release Dosage Form: An Opportunity to Prolong the Release of Drug. Int J Advanced Res Pharm & Bio Sci., 2013; 3(1): 7-14.
9. Chowdary KPR and Kalyani GS. Recent Research on Matrix Tablets for Controlled Release – A Review. Int Res J Pharmaceutical & Applied Sci., 2013; 3(1): 142-148.
10. Gennaro AR. (Ed.) Remington's. pharmaceutical science. 20th Edn. Lippincott Williams and wilkini publishing co, Newyork, 2000; 1: 905-06.
11. Zalte HD, Saudagar RB. Review on Sustained Release Matrix Tablet. Int J Pharm & Bio Sci., 2013; 3(4): 17-29.
12. Neetu K, Ajay B, Kumar KM, Ankit G. Patented Pharmaceutical Oral Controlled Release Matrix System. J Biological & Scientific Opinion, 2013; 1(3): 263-270.
13. Patel H, Panchal DR, Patel U, Brahmbhatt T, Suthar M. Matrix Type Drug Delivery System : A Review. J Pharm Sci Biosci Res., 2011; 1(3): 143–51.
14. Dash TR, Varma P. Matrix Tablets: An Approach Towards Oral Extentded Release Drug Delivery. Int J Pharma Res & Review, 2013; 2(2).