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Der Pharmacia Lettre, 2011: 3 (4) 380-392
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USA CODEN: DPLEB4

Preparation and Evaluation of Extended Release Matrix Tablets of Diltiazem Using Blends of Tamarind Xyloglucan with Gellan gum and Sodium carboxymethyl cellulose

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ABSTRACT

The objective of the present work was to develop once daily matrix tablets of water soluble drug diltiazem hydrochloride using natural polymers and gums like tamarind xyloglucan, gellan gum and sodium carboxymethyl cellulose, either alone or in combinations. Tablets were prepared by wet granulation method and evaluated for various physical parameters. Tamarind xyloglucan with gellan gum and sodium carboxymethyl cellulose sustained the drug release effectively for 24 hrs. All the formulations followed first order kinetics. The release co-efficient values 'n' (>0.5) indicated that the drug release followed non fickian anomalous mechanism based on formulation factors. Release profile of formulation T2 and TS1 were comparable with the marketed product which is supported by the model independent parameters like MDT of 6.84 and 8.47 hrs, the dissolution efficiency of 56.01 and 50.61 in 8 hrs and the $t_{90\%}$ values were 18.96 and 20.28 hrs respectively. The results have shown that the tablets can be useful as once daily formulations.

Key words: Extended release, Diltiazem hydrochloride, Tamarind xyloglucan, Gellan gum, Sodium carboxymethyl cellulose, Wet granulation.

INTRODUCTION

Increased complications and expense involved in discovery of new drug entities has greater attention on development of sustained release or controlled release drug delivery system. Among various dosage forms, matrix tablets are widely accepted for oral controlled release as they are simple to formulate. This system prolongs or controls release of drug that is dissolved or dispersed in the matrix. Polymers and release retarding materials are used as matrix forming materials. They play a vital role in controlling the drug release from the matrix materials [1].

Natural gums and polysaccharides and their derivatives represent a group of polymers widely used in pharmaceutical dosage forms. Polysaccharides are the choice of materials among the hydrophilic polymers used, because they are nontoxic and acceptable by the regulatory

authorities. The various polysaccharides used in drug delivery application are cellulose ethers, xanthan gum, locust bean gum and guar gum [2, 3].

Tamarind kernel polysaccharide obtained from the seed kernels of *Tamarindus indica* belongs to family Leguminoceae, possesses properties like high viscosity, broad p^H tolerance, noncarcinogenicity, mucoadhesive nature and biocompatibility. It is a branched polysaccharide with a main chain of β-d-(1,4)-linked glocopyranosyl units, and that a side chain consisting of single d-xylopyranosyl unit attached to every second, third and fourth d- glocopyranosyl unit though an α-d (1,6) linkage. One d-galatopyranosyl unit is attached to one of the Xylopyranosyl unit through a β-d-(1, 2) linkage [4, 5].

In this work we have used Diltiazem hydrochloride as a model drug for design of extended release matrix tablets. Diltiazem hydrochloride is used in treatment of hypertension and angina pectoris. Diltiazem hydrochloride is rapidly and completely absorbed from gastro-intestinal tract following oral administration, but it undergoes extensive first-pass hepatic metabolism. Its plasma half life is reported to be about 3-5 hours. In hypertension it is given 60-120 mg. twice a daily. To reduce repeated administration of drug extended release formulation of Diltiazem hydrochloride is required [6].

MATERIALS AND METHODS

Materials: Diltiazem hydrochloride was obtained as a gift sample from Abbott laboratories Ltd, Haridwar. Tamarind kernel powder procured commercially. Gellan gum was obtained from Sigma-Aldrich USA. Sodium carboxy methyl cellulose (sodium CMC) was purchased from Himedia laboratories Ltd, Mumbai. All other chemicals used were of analytical grade.

Methods:
Isolation of tamarind xyloglucan from TKP (Tamarind kernel powder): The isolation of xyloglucan was performed by following the method reported earlier. 20 g of tamarind kernel powder was added to 200 ml of cold distilled water to prepare slurry. The slurry was poured into 800 ml of boiling distilled water. The solution was boiled for 20 min with continuous stirring. The resulting solution was kept overnight and centrifuged at 5000 rpm for 20 min. The supernatant liquid was separated and poured into twice the volume of absolute alcohol with continuous stirring. The precipitate obtained was washed with absolute ethanol and air-dried. The dried polymer was milled, passed through sieve no.85 and stored in desiccators until further use [2, 3].

Compatibility Study:
Fourier transform infra red spectroscopy (FTIR): The samples of drug, polymer and their mixture were prepared in the form of potassium bromide pellets and subjected for scanning from 4000 cm^{-1} to 400 cm^{-1} using FT-IR spectrophotometer (FT-IR-8400, Shimadzu, Japan).

Differential scanning calorimetry (DSC): Approximately 2 mg samples of drug, polymer and their mixture was taken in aluminum pan, sealed with aluminum cap and kept under nitrogen purging (atmosphere). The samples were scanned from 0-300°C with the scanning rate of 10°C rise/min using differential scanning calorimeter (DSC-60, Shimadzu, Japan).

Preparation of matrix tablets: Tablets were prepared by wet granulation method. Drug, polymers and all other excipients were passed through sieve #80 before use. A physical mixture of drug and polymers was suitably moistened with required quantity of polyvinyl pyrolidone

K30 in isopropyl alcohol (5 % w/v) and sieved (#16) to get the wet granules. The granules were dried at 40º C for 2 h, and the dried granules were resized using sieve (#22) to get the uniform sized granules. The dried granules were admixed with talc and magnesium stearate and compressed on a single station tablet machine (Cadmach machinery Co. Private, Ltd Ahmadabad India) using a flat faced 10.05 mm punches (table 1).

Table 1: Composition of diltiazem matrix tablets

Formulation Code	Drug	Tamarind xyloglucan	Gellan gum	Sodium CMC	lactose	Total weight mg
T 1	90	100	-	-	153	350
T 2	90	150	-	-	103	350
T 3	90	200	-	-	53	350
G	90	-	100	-	153	350
TG 1	90	100	50	-	103	350
TG 2	90	100	100	-	53	350
TG 3	90	150	50	-	53	350
TG 4	90	150	100	-	3	350
TG 5	90	200	50	-	3	350
TG 6	90	200	100	-	2	400
S	90	-	-	200	53	350
TS 1	90	150	-	50	53	350
TS 2	90	150	-	100	3	350
TS 3	90	200	-	50	3	350
TS 4	90	200	-	100	2	400

Each tablet contains 1%w/w talc and magnesium stearate.

EVALUATION OF TABLETS:

Physical properties: Prepared tablets were evaluated for tablet dimensions, weight variation, hardness and friability.

Drug content: Drug content was determined by crushing the tablets in a glass mortar and pestle and extracting the drug in phosphate buffer pH 7.4 with continuous shaking on a rotary shaker (Remi instruments Ltd, Mumbai, India) for 24 h. The drug content in extracted fluid was analyzed using a UV-Spectrophotometer (UV- 1601, Shimadzu, Japan) at 237nm against suitable blank.

Swelling studies: Pre weighed tablets with wire mesh basket were placed in the medium (phosphate buffer pH 7.4). At different time intervals the weight of the swollen tablet was recorded after wiping of the excess of water. The swelling index was calculated by using the following equation.

$$\text{Swelling Index} = \frac{(W_t - W_o)}{W_o}$$

Where, W_o – Initial weight of tablet and W_t – weight of the tablet at time‘t’.

***In vitro* drug release:** The drug release study was performed using six station USP -XXIII dissolution test apparatus 2 (Tab machines, Mumbai, India) with a paddle speed of 50 rpm. Dissolution medium consisted of 900 ml of phosphate buffer pH 7.4 maintained at 37±0.5º C. At

a predetermined time intervals an aliquot was withdrawn and replenished with fresh medium. Amount of drug in each aliquot was assayed on a UV-Spectrophotometer (Shimadzu 1601, Japan) at 237nm after dilution using a suitable blank. All trials were conducted in triplicate and the average (± S.D) reading was noted. Cumulative drug release was plotted as a function of time.

Drug release mechanism: Experimental data were fit to following kinetic equation to determine the order and mechanism of drug release [7, 8].

Zero order equation: $Q_t = K_{ot}$

First order equation: $Q_t = Q_o e^{-Kt}$

Higuchi's square root model: $Qt = K_H\sqrt{t}$

Where ´Q_t´ is amount of drug released at a time *t*, Q_o is the initial amount of drug in the dissolution medium. *K*, K_o and K_H are release constants.

In order to further determine the mechanism of drug release, data were fit to Korsmeyer-Peppas empirical power law equation [9].

$$M_t/M_\infty = Kt_n$$

Where M_t/M_∞ is the fraction of drug released at a time'*t*', *K* is the structural and geometrical constant and '*n*' is the release exponent.

Weibull model:
The Weibull equation expresses the accumulated fraction of the drug, *m*, in solution at time, *t*,

$$m = 1 - \exp\left[\frac{-(t - T_i)^b}{a}\right]$$

In this equation, the scale parameter, *a*, defines the time scale of the process. The location parameter, T_i, represents the lag time before the onset of the dissolution or release process and in most cases will be zero and '*b*' is the shape parameter [10].

Model independent approaches:
Dissolution efficiency (DE %): Dissolution efficiency was calculated by using following equation

$$DE\ \% = \frac{\int_0^t y\ dt}{y_{100}t} \times 100$$

Where, *y* is the drug percent dissolved at time *t [11]*.

Mean dissolution time (MDT): It is used to characterize the drug release rate from a dosage form and indicates the drug release retarding efficiency of the polymer. MDT was calculated by using the following equation [11].

$$MDT = \frac{\sum_{i=1}^{i=n} t_{mid} \times \Delta M}{\sum_{i=1}^{i=n} \Delta M}$$

Where *'i'* is the dissolution sample number, *'n'* is the number of dissolution sample time, *'t_{mid}'* is the time at the midpoint between *'i'* and *'i-1'*, and *'ΔM'* is the amount of drug dissolved between *'i'* and *'i-1'*.

Similarity factor (f_2): The similarities between two dissolution profiles were determined by model independent procedure such as similarity factor (f_2).

$$f_2 = 50 \log \left\{ \left[1 + \left(\frac{1}{n} \right) \sum_{t=1}^{n} (R_t - T_t)^2 \right]^{-0.5} \times 100 \right\}$$

Where *'n'* is the number of pull points, *'Rt'* is the reference profile at time point*'t'*, and *'Tt'* is the test profile at the same time point [12].

Difference factor (f_1): The difference factor (f_1) calculates the percent difference between the two curves at each time point and is a measurement of the relative error between the two curves [12].

$$f_1 = \{[\sum_{t=1}^{n} | R_t - T_t |] / [\sum_{t=1}^{n} R_t]\} \bullet 100$$

Stability study

The best formulation was subjected for one month stability study according to ICH guidelines by exposing the tables in their final packing mode to the temperature 40±2°C and relative humidity 75±5 % in programmable environmental test chamber (CHM-10S, Remi Instruments Ltd., Mumbai, India). At the end of one month the tablets were analyzed for any change in appearance, physical attributes, drug content and *in vitro* drug release.

STATISTCAL ANALYSIS

The data obtained from the dissolution studies were statistically analyzed by one way ANOVA followed by Tukey method. A probability value of $P < 0.05$ was considered as statistically significant.

RESULTS AND DISCUSSION\

In this investigation is an attempt to develop sustained release matrix tablets containing diltiazem hydrochloride as model drug.

Compatibility studies are carried out to find out compatibility between drug and excipients used in the formulations. The characteristic peaks associated with diltiazem hydrochloride c=o (acetate) at 1710 cm -1, lactam c=o(s) at 1681 cm -1were present in all the FTIR spectra involving drug and polymers. This shows that there are no considerable changes in the position of characteristic bands associated with drug and individual ingredients, thus there is no interaction between drug-polymer and polymer-polymer (figure 1 & 2).

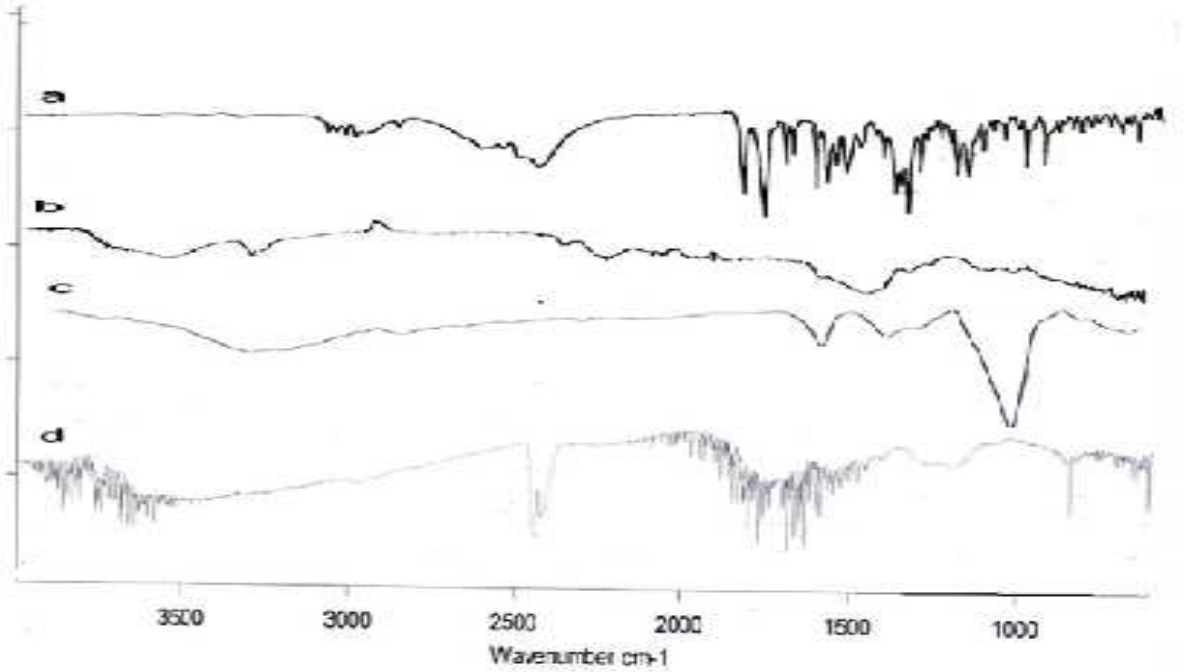

Figure 1: FT-IR spectra of (a) Diltiazem HCl (b) Tamarind xyloglucan (c) Gellan gum (d) Sodium CMC.

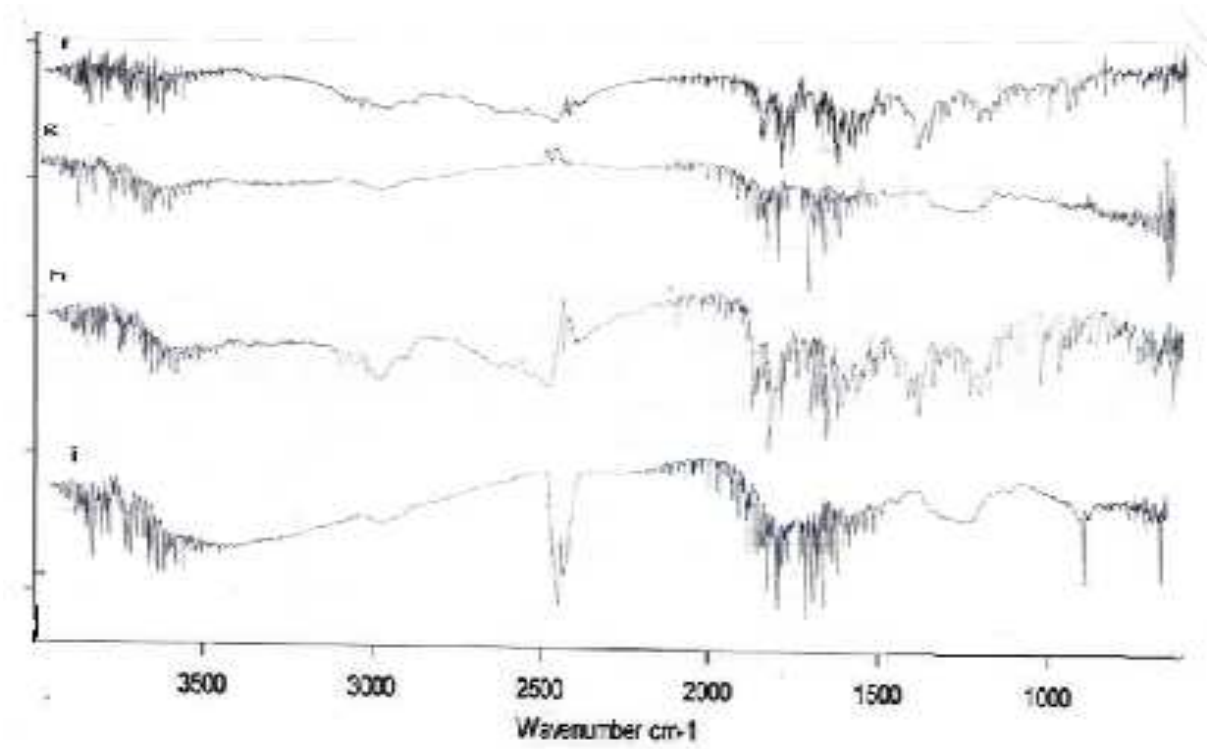

Figure 2: FT-IR spectra of (f) Diltiazem HCl and tamarind xyloglucan (g) Formulation TG1 (h) Diltiazem HCl, tamarind xyloglucan and gellan gum (i) Formulation TS1

The melting point of pure drug is 212.29 ^{0} and tamarind xyloglucan shows a exothermic peaks at 300.1^0 due to its decomposition and the endothermic peak is present at 38.66 ^{0} The DSC thermograms of gellan gum shows the endothermic peak at 88.16^0 and exothermic peak at 267.80 ^{0} The endothermic peak of sodium carboxy methyl cellulose is present at 56.12 ^{0} C (Figure 3 and 4). The DSC thermo grams of drug in combination with the polymers revealed that peaks are very slightly shifted from their original positions so there is no incompatibility between drug and polymers.

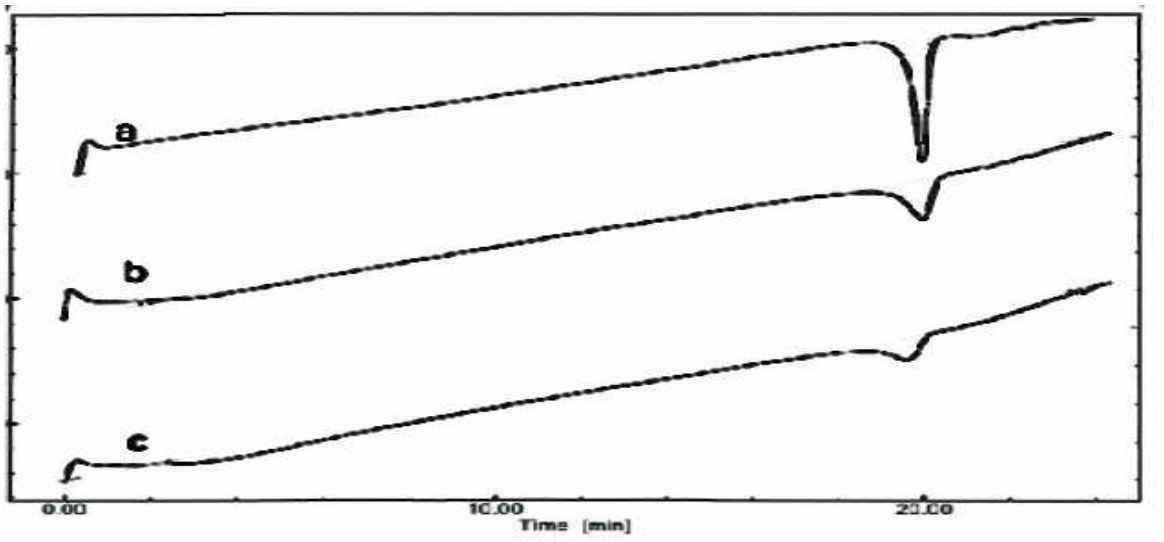

Figure 3: DSC thermograms of (a) Diltiazem HCl (b) Diltiazem HCl and tamarind xyloglucan (c) Diltiazem HCl, tamarind xyloglucan and gellan gum.

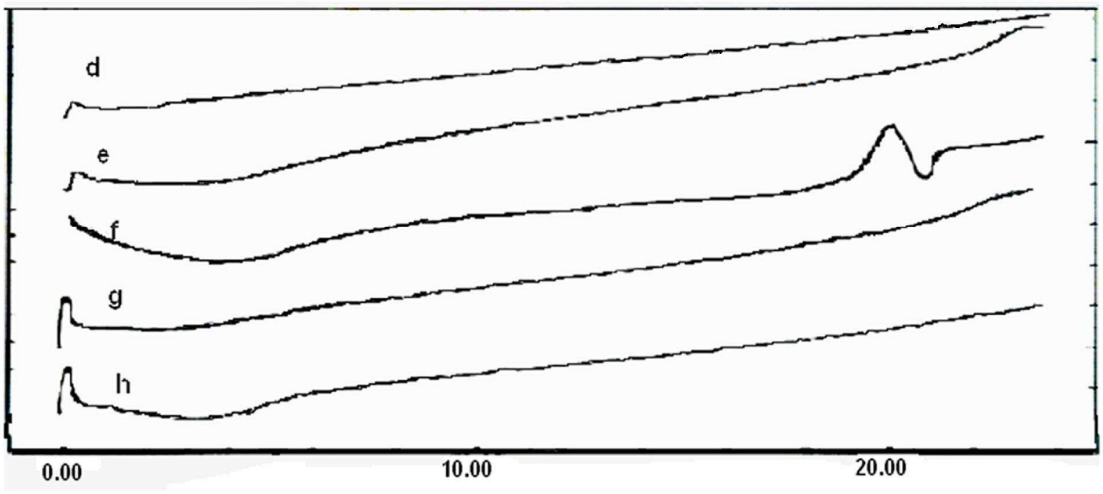

Figure 4: DSC thermograms of (d) Tamarind xyloglucan (e) TG1 (f) Gellan gum (g) TS1 (h) Sodium CMC

The bulk and tapped density of prepared granules are found to be in the range of 0.194 – 0.331 and 0.218 – 0.390, respectively. Carr's compressibility index and Hausner ratio are determined to be less than 19% and <1.22 for all formulations respectively, which indicates that the prepared granules of all the formulations have fair to good flow property. The results of angle of repose indicate that the granules of all the formulations are free flowing and further by the incorporation of the glidants at 1%, the flow ability of the granules improved.

The physical properties of tablets like hardness, friability, thickness, diameter, drug content and weight variation are found to be within limits (table 2) indicating that the prepared matrix tablets met the USP specifications.

Table 2: Physical properties of tablets

F Code	Diameter (mm)	Thickness (mm)	Hardness (kg/cm^2)	Friability (%)	Weight variation(mg)	Drug Content (%)
T1	10.07±0.02	3.61±0.01	6.43±0.50	0.66±0.02	350.3±1.52	97.64±0.72
T2	10.09±0.01	3.40±0.03	6.39±0.43	0.81±0.06	349.6±1.52	96.16±0.86
T3	10.09±0.04	3.34±0.02	7.3±0.22	0.48±0.06	351.3±1.15	95.55±0.63
G	10.10±0.005	3.31±0.06	6.36±0.12	0.83±0.04	351.3±0.57	97.44±0.36
TG1	10.06±0.003	3.37±0.01	6.75±0.74	0.81±0.16	350.0±1.00	95.75±0.88
TG2	10.12±0.005	3.44±0.03	6.96±0.06	0.70±0.18	351.3±1.15	96.76±1.08
TG3	10.11±0.01	3.33±0.03	7.08±0.42	0.82±0.08	353.3±0.57	97.77±0.82
TG4	10.13±0.006	3.46±0.005	6.52±0.04	0.56±0.08	351.0±1.00	96.96±0.30
TG5	10.08±0.005	3.42±0.01	6.50±0.005	0.42±0.29	351.3±2.30	97.97±2.88
TG6	10.12±0.001	4.20±0.005	7.04±0.06	0.86±0.03	400.6±2.08	100.11±4.11
S	10.07±0.02	3.57±0.02	6.46±0.21	0.79±0.13	351.6±0.57	101.66±3.22
TS1	10.10±0.01	3.41±0.005	6.5±0.04	0.84±0.06	353.3±0.57	97.77±2.11
TS2	10.09±0.002	3.45±0.005	7.24±0.22	0.49±0.13	350.3±0.57	98.22±2.55
TS3	10.0±0.017	3.36±0.02	6.54±0.02	0.68±0.20	352.0±1.73	98.77±3.44
TS4	10.13±0.01	4.06±0.07	6.50±0.05	0.82±0.12	402.6±2.51	100.00±0.006

F Code= Formulation code

The swelling index of tablets in is determined in phosphate buffer pH 7.4 for 24 hrs. After 8 hrs the tablets erode. The swelling index is directly proportional to the concentration of the tamarind xyloglucan. As the concentration of tamarind xyloglucan increases there is an increase in swelling index. The initial increase and subsequent decrease in swelling index is probably due to the erosion of surface layer of matrix tablet and the order of swelling is found to be T3 > T2 > T1. While, in case of only gellan gum due to its high water solubility and swelling property, it showed complete erosion within 2 hrs. The results of swelling studies are shown in figure 5.

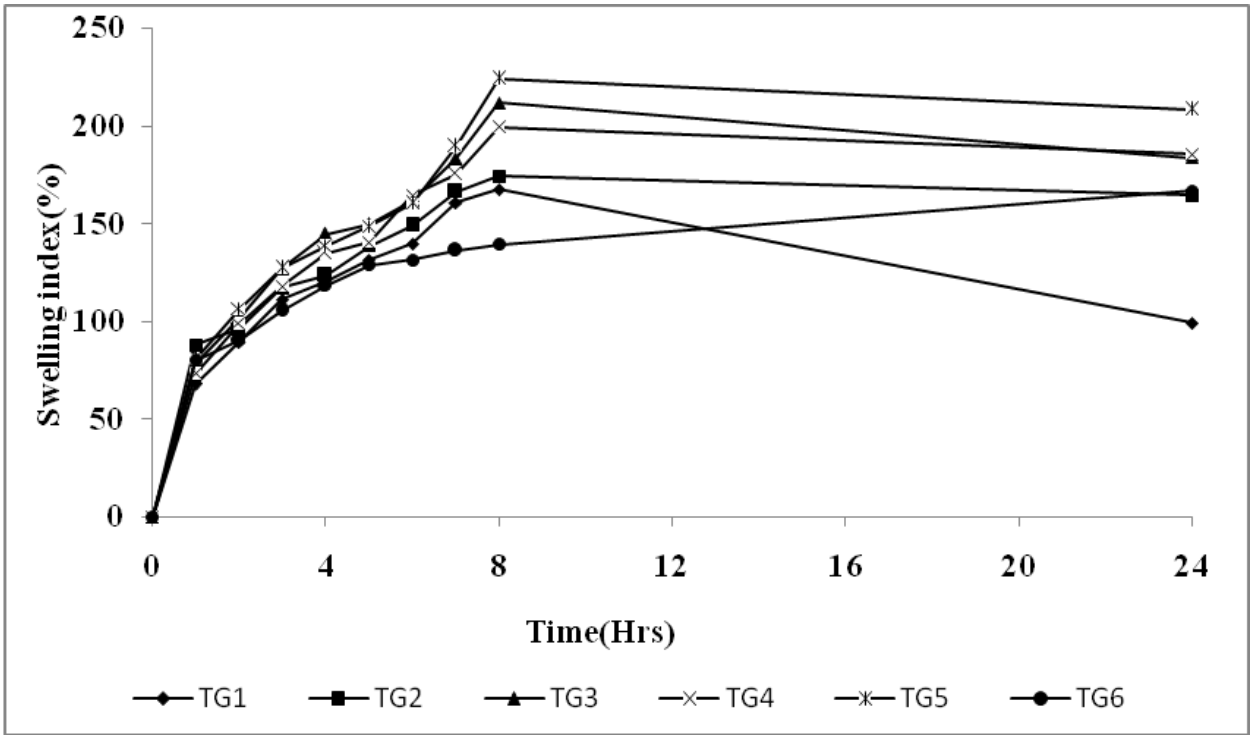

Figure 5: Swelling profile of formulations from TG1 to TG6 in pH 7.4

For all the combinations of tamarind xyloglucan and gellan gum, the swelling study up to 8 hrs shows rise in the swelling index ranging from 139 to 224%, however after 8 hrs only TG6 shows slow rise in swelling index. The higher concentration of gellan gum rendered highly dense nature due to synergistic interaction and low water permeability. Formulation of tamarind xyloglucan and sodium CMC get eroded within 8 hrs. In alkaline medium sodium CMC eroded faster than acidic medium owing to its acidic nature.

From the *in vitro* dissolution data (figure 6), it was found that formulations T1 to T3, G and S containing tamarind xyloglucan, gellan gum and sodium CMC released 85.84±3.92 to 99.62±0.54% (24 hrs), 99.36±0.54%(2 hrs) and 100.30±0.60% (8 hrs) of drug respectively, except formulation containing gellan gum, all the formulations showed better drug release profile for 24 hrs. Formulation containing gellan gum and sodium CMC showed drug release within 2 and 8 hrs due to high swelling property and erosion in alkaline media respectively. The *in vitro* drug release profiles of the prepared formulations are shown in figures 6 to 9.

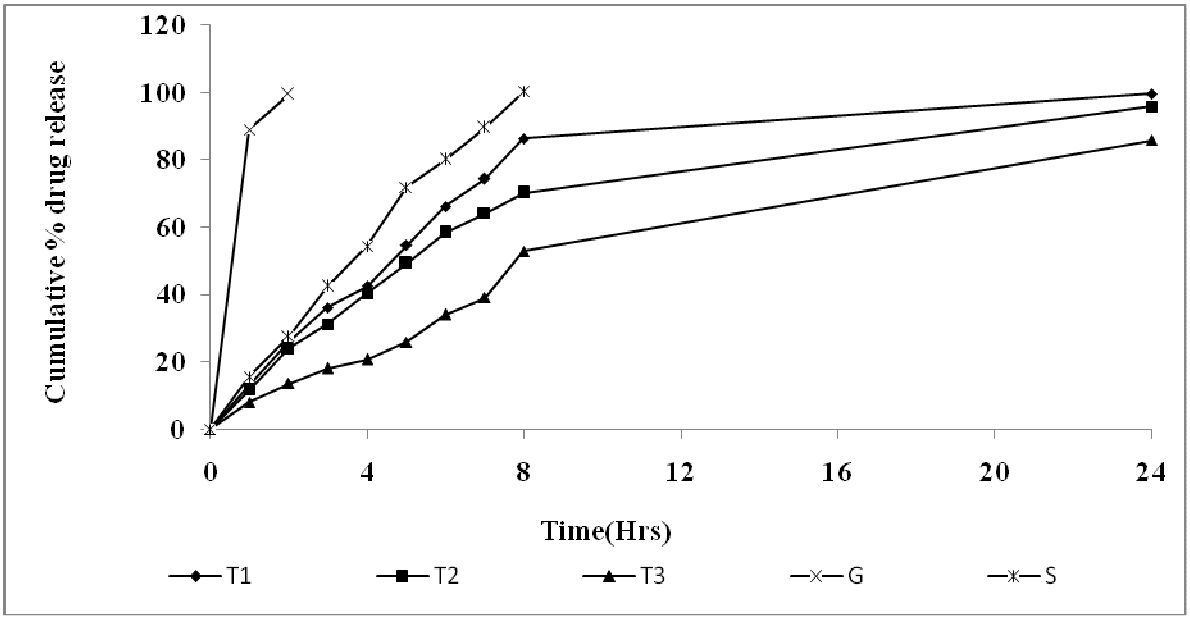

Figure 6: Release profile of diltiazem hydrochloride from extended release tablets with of tamarind xyloglucan, gellan gum and sodium CMC in pH 7.4

The formulation TG1 shows higher drug release whereas other formulations of tamarind xyloglucan in combination with gellan gum show lower drug release as compared to the marketed formulation due to higher proportion of both the polymer and synergetic interaction between them (figure 7). The formulation TS4 showed higher drug release and other formulations of tamarind xyloglucan in combination with sodium CMC showed lower drug release as compared to the marketed formulation (figure 8). Moreover, formulation TS1 shows similar drug release profile as that of marketed formulation. The formulation T2 and TS1 were also compared with and found to have similar drug release profile to the marketed formulation (figure 9).

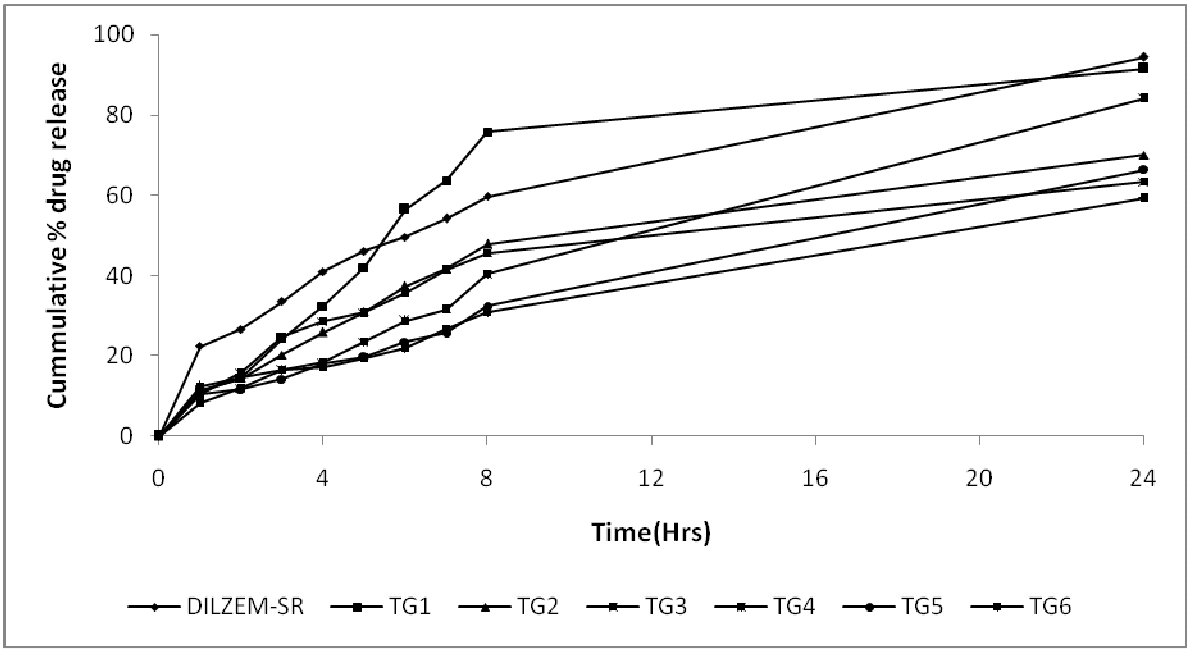

Figure 7: *In vitro* drug release profiles from the tablets containing combination of tamarind xyloglucan and gellan gum i.e. TG1 to TG6 and comparison with DILZEM-SR (M.F.) in pH 7.4

All the prepared formulations followed the first order kinetics. (r^2 value close to 1) The data from dissolution studies was further fit to Higuchi's equation to analyze drug release mechanism. The r^2 values of Higuchi's plot indicated that the formulation exhibit linearity towards diffusion mechanisms with a correlation values in the range of 0.8380- 0.9720. Further the data treatment using Korsmeyer-Peppas equation indicated that all the formulations have the 'n' value > 0.5. The value of $n \leq 0.5$ indicates quasi-Fickian diffusion mechanism. For $n > 0.5$, an anomalous non-Fickian diffusion and the special case of $n = 1$ that has gained importance due to its potential application in the development of swelling controlled drug delivery systems. The results indicate that the drug was released by a combination of diffusion as well as polymeric chain relaxation; however formulation TS4 showed the 'n' value of 1.124 which indicates swelling as well as erosion, as a drug release mechanism (table 3).

Table 3: Kinetics of drug release from Diltiazem hydrochloride matrix tablets

Formulation	Correlation coefficient (r^2)				Release exponent (n)	Weibull factor (b)
	Zero order	First order	Higuchi	Korsmeyer & peppas		
T1	0.6670	0.9790	0.8870	0.9050	0.6850	0.9626
T2	0.7690	0.9950	0.9410	0.9310	0.6890	0.9154
T3	0.9200	0.9880	0.9420	0.9720	0.7860	0.9537
G	1.000	0.9980	0.9610	1	0.8690	1.0733
TG1	0.7050	0.9280	0.8830	0.9040	0.7710	0.9914
TG2	0.7290	0.8260	0.9080	0.9250	0.6540	0.8108
TG3	0.8270	0.9070	0.9660	0.9600	0.6950	0.7052
TG4	0.9830	0.9860	0.9380	0.9840	0.7490	0.9114
TG5	0.9870	0.9930	0.9460	0.9440	0.6160	0.7232
TG6	0.9480	0.9850	0.9590	0.9170	0.5030	0.5917
S	0.9920	0.9430	0.9370	0.9970	0.9150	1.2262
TS1	0.8840	0.9920	0.9580	0.9680	0.7610	0.989
TS2	0.9160	0.9950	0.9720	0.9570	0.7650	0.9508
TS3	0.9300	0.9900	0.9440	0.9850	0.7160	0.8688
TS4	0.7170	0.7840	0.8380	0.8970	1.124	1.4797
Marketed	0.924	0.9950	0.9940	0.9870	0.4790	-

Table 4: Model independent parameters and similarity and difference factors for Diltiazem hydrochloride release from different formulations

*Form*ulation	%DE (8 Hrs)	MDT (Hrs)	f_2 factor	f_1 factor	$t_{25\%}$ (Hrs)	$t_{90\%}$ (Hrs)
T1	51.66	5.53	43.78	21.30	2.27	16.79
T2	56.01	6.84	57.82	11.82	0.75	18.96
T3	43.95	8.91	41.07	30.33	4.25	23.62
G	69.95*	0.60*	-	-	-	-
TG1	47.07	6.25	50.53	18.87	0.55	19.64
TG2	50.75	9.28	45.95	20.89	1.33	26.11
TG3	57.43	6.55	40.10	30.55	3.18	33.51
TG4	49.31	10.40	36.41	38.24	5.37	25.15
TG5	53.39	9.99	31.42	47.97	6.86	33.16
TG6	58.34	9.36	30.56	48.71	7.40	36.64
S	53.37	3.71	30.52	48.65	1.69	6.98
TS1	50.61	8.47	52.80	14.72	2.28	20.28
TS2	50.66	8.93	48.70	21.29	3.20	22.09
TS3	53.77	10.42	35.47	40.11	5.53	26.37
TS4	35.92	7.07	40.03	28.99	2.36	17.59
Marketed	64.19	7.82	-	-	0.85	20.85

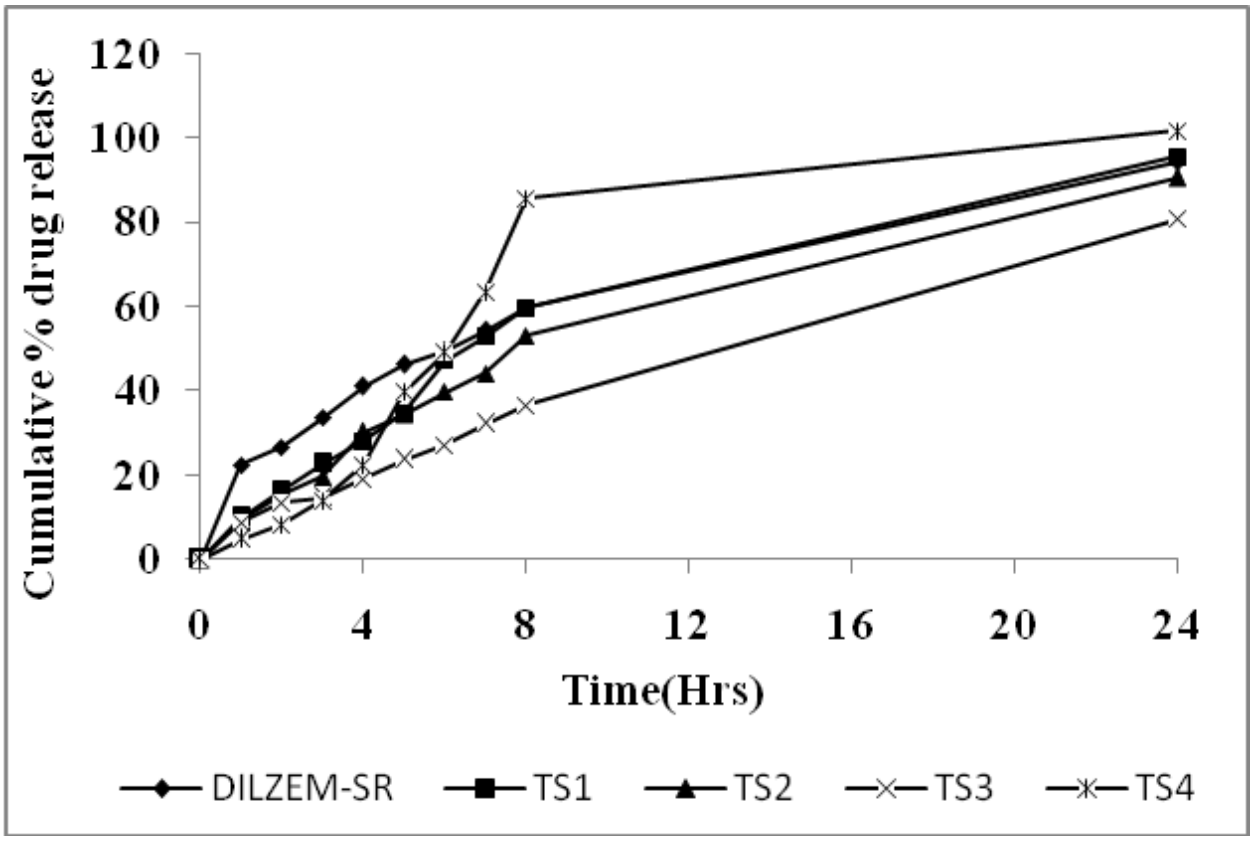

Figure 8: *In vitro* drug release profiles from the tablets containing combination of tamarind xyloglucan and sodium CMC and comparison with DILZEM-SR (M.F.) in pH 7.4

The release rate of diltiazem hydrochloride from only tamarind xyloglucan was higher than that from tamarind xyloglucan with gellan gum and with sodium CMC combination matrices, which is confirmed by MDT. MDT of formulation TG4 and TS3 is 10.40 and 10.42 hrs respectively. The % dissolution efficiency of all the formulations ranges from 41 to 59% in 8 hrs, whereas for formulation G having % dissolution efficiency is 69.95% in 2 hrs. The similarity factor (*f2*) was used to compare the dissolution profiles of the prepared formulations with marketed product DILZEM SR (Torrent Pharma). The *f2* values showed that only formulation T2, TG1 and TS1

are similar to reference product with values above 50. The dissimilarity factor (*f*1) was also used to compare the release profiles of the prepared formulations with marketed product DILZEM - SR. The *f1* values for all the formulation above 15 except T2 and TS1. So the formulation T2 and TS1 showed an overlapping drug release profile. The values for $t_{90\%}$ range from 6.98-36.64 hrs (table 4).

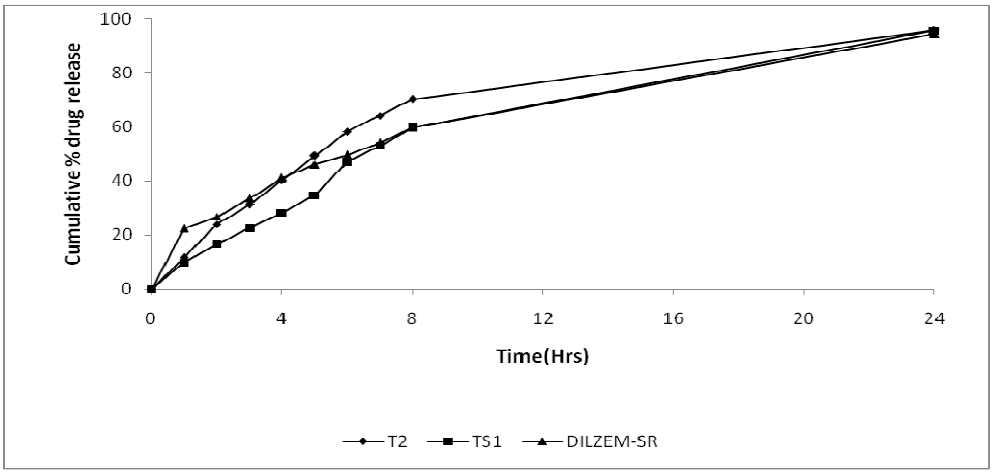

Figure 9: Comparison of release profiles of T2, TS1 formulation and marketed product (DILZEM-SR)

The formulation T2 and TS1 gave similar value for $t_{25\%}$ and $t_{90\%}$, when compared to marketed formulation. Besides of these, Formulations T3, TG1 and TS2 showed higher value for $t_{90\%}$ that is 23.62, 19.64 and 22.09 respectively. From the results it was found that these formulations are also feasible to be used as extended release tablets of diltiazem hydrochloride.

The stability studies showed that there was no significant change in dissolution profile after storage (table 5).

Table 5*: In vitro* drug release of T2 before and after stability studies

Time	Cumulative % drug release	
	Initially	After stability Studies
0	0	0
1	11.57±1.07	10.38±0.34
2	23.91±3.05	20.40±0.49
3	31.20±4.00	26.71±0.65
4	40.26±1.26	36.76±0.79
5	49.29±4.01.	47.82±0.54
6	58.34±3.00	55.46±0.31
7	64.14±4.00	60.93±0.50
8	70.16±0.99	68.95±0.61
24	95.78±2.16	94.48±1.24

Statistical analysis revealed that the dissolution profiles of the formulations TG3- TG4, TG5-TG6 as well as TS1 and TS2 are not significantly different ($p > 0.05$).

CONCLUSION

The present study was carried out to evaluate the tamarind xyloglucan for its matrix forming ability. Matrix tablets of diltiazem hydrochloride prepared with combination of tamarind xyloglucan with gellan gum and sodium CMC were also found to have good physical properties. During this study, it was also found that drug: polymer concentration ratio influences the drug

release behaviour. The formulations prepared by combination of tamarind xyloglucan with gellan gum and sodium CMC retarded the drug release effectively for 24 hrs. Formulations T2 and TS1 exhibited similar drug release profile as that of marketed product. Formulations T2 and TS1 along with T3, TG1, TS2, X and TX2 found to be suitable as once a day extended release matrix tablets.

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