ORIGINAL ARTICLE

Design and Clinical Evaluation of Floating Mini Matrix Tablets of Pyridoxine Hydrochloride

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Abstract

Objective: The aim of this investigation was to prepare multiple unit floating mini matrix tablets of pyridoxine hydrochloride which is having an absorption window in the upper part of gastrointestinal tract, i.e., jejunum. Hence, this study was planned to formulate, characterize with *in-vitro* and *in-vivo* evaluation in human subjects. **Materials and Methods:** In this investigation, multiple unit floating mini matrix tablets of pyridoxine HCl were formulated using hydroxy propyl methyl cellulose K grade polymers along with ethyl cellulose by wet granulation method. The physicochemical characteristics of all the prepared batches were evaluated. The *in-vitro* buoyancy and *in-vitro* drug release studies were conducted in the study. Based on *in-vitro* buoyancy and *in-vitro* drug release, optimized formulation was selected and subjected to stability studies as per WHO and ICH guidelines for 6 months. The optimized formulation was further subjected to X-ray studies to establish the *in-vivo* gastric residence time in human volunteers by replacing the drug with X-ray grade barium sulfate. **Results:** The physicochemical characteristics of all the prepared batches were found to be satisfactory. All the prepared batches showed good *in-vitro* buoyancy and it was observed that the mini tablets remained buoyant for more than 12 h. The formulation FP8, which released complete drug release in 12 h with minimum floating lag time of 16 ± 2.54, was considered as optimized formulation. The stability studies indicated that the optimized formulation is stable during its stability period. The *in-vivo* radiographic studies revealed that the mini tablets remained in the stomach up to 6 h in human volunteers and altered its position without any adhesion to walls of stomach. **Conclusion:** Based on *in-vitro* characteristics and *in-vivo* radiographic studies, it can be concluded that the best formulation FP8 by choosing multiple unit floating matrix tablets could improve patient compliance and ensure better drug absorption.

Key words: Ethyl cellulose, hydroxy propyl methyl cellulose, pyridoxine hydrochloride, stability studies, X-ray studies

INTRODUCTION

Drug exhibiting absorption from only a particular portion of gastrointestinal tract (GIT) or showing the difference in absorption from various regions of GIT is said to have regional variability in intestinal absorption. Such drugs show absorption window which signifies the regions of GIT from where absorption primarily occurs.[1,2] Drug released from the controlled release drug delivery system (CRDDS) after the absorption window has been crossed goes waste with no or negligible absorption occurring. This phenomenon drastically decreases the available drug for absorption after release of drug from CRDDS. The CRDDS possessing the ability of being retained in the stomach are called gastroretentive drug delivery systems (GRDDS), and they can help in optimizing the oral controlled delivery of drugs having absorption window by continuously releasing drug before absorption window, for prolonged period thus ensuring optimal bioavailability.[3,4] However, the problems such as all or nothing emptying of single unit floating dosage forms made them unreliable and reproducible in prolonging gastric

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residence time that led to the development of multiple unit dosage forms.[5-7] Pyridoxine hydrochloride, i.e., vitamin B6 is having an absorption window in the upper part of GIT, i.e., jejunum. Therefore, it was considered as a good candidate for incorporating into a gastroretentive dosage form.

MATERIALS AND METHODS

Materials

Pyridoxine HCl was obtained as a gift sample from Dr. Reddys Laboratories, Hyderabad, Telangana, India. Hydroxypropyl methyl cellulose (HPMC) K_4M, HPMC $K_{15}M$, HPMC $K_{100}M$, and ethyl cellulose was obtained as a gift sample from AET Laboratories, Hyderabad, Telangana, India. Lactose anhydrous was procured from Loba Chemicals Pvt. Ltd., India. Concentrated HCl, magnesium stearate, talc, isopropyl alcohol, and polyvinylpyrrolidone (PVP) K30 were procured from local suppliers.

Formulation of floating mini matrix tablets of pyridoxine HCl

The mini matrix tablets of this research work are prepared by wet granulation method. In a mortar, pyridoxine HCl along with all the excipients as shown in Table 1, such as polymers HPMC K_4M, HPMC $K_{15}M$, HPMC $K_{100}M$, ethylcellulose, lactose anhydrous, and sodium bicarbonate, is mixed uniformly and nonaqueous granulation was carried out by using 10% of PVP in isopropyl alcohol solution. Wet mass was passed through 10 mesh and wet granules were dried at 50-60°C for 30 min. Dried granules were again passed through the 18 mesh and lubricated with magnesium stearate and talc. Finally, entire granules were mixed uniformly in a polybag for 5 min. The final blend was compressed into mini tablets using 4 mm size round concave multi tip punches and corresponding dies on 16 stations rotary compression machine (Cemach, India). In this work, according to the tablet weight, 10 mini tablets are filled in one 000 size gelatin capsule.

Evaluation of the developed formulations

Drug-excipient compatibility studies by Fourier transform infrared (FTIR) spectroscopy

Infrared spectra were taken by KBr pellet technique using a Bruker Alpha FTIR Spectrophotometer from 400 to 4000 cm^{-1} wavelength region. The procedure consisted of dispersing a sample (drug alone and optimized formulation of drug) in KBr and compressing into discs by applying a pressure of 5 tons. The FTIR spectra of samples were obtained using FTIR spectroscopy.

Evaluation of physical parameters of floating mini matrix tablets of pyridoxine HCl

Weight variation test

The weight variation test was carried out by taking 20 tablets randomly from each batch. Each tablet weight

Table 1: Tablet composition of floating mini matrix tablets of pyridoxine HCl

Formulation code	Drug (pyridoxine HCl) (mg)	HPMC K_4M+ethyl cellulose (1:1) (mg)	HPMC $K_{15}M$+ethyl cellulose (1:1) (mg)	HPMC $K_{100}M$+ethyl cellulose (1:1) (mg)	Lactose anhydrous (mg)	Effervescent agent ($NaHCO_3$) (mg)	Mg.stearate (mg)	Talc (mg)
FP1	5	10	-	-	31	2.5	0.5	1
FP2	5	15	-	-	26	2.5	0.5	1
FP3	5	20	-	-	21	2.5	0.5	1
FP4	5	25	-	-	16	2.5	0.5	1
FP5	5	30	-	-	11	2.5	0.5	1
FP6	5	-	10	-	31	2.5	0.5	1
FP7	5	-	15	-	26	2.5	0.5	1
FP8	5	-	20	-	21	2.5	0.5	1
FP9	5	-	25	-	16	2.5	0.5	1
FP10	5	-	30	-	11	2.5	0.5	1
FP11	5	-	-	10	31	2.5	0.5	1
FP12	5	-	-	15	26	2.5	0.5	1
FP13	5	-	-	20	21	2.5	0.5	1
FP14	5	-	-	25	16	2.5	0.5	1
FP15	5	-	-	30	11	2.5	0.5	1

Each mini tablet weight is 50 mg, 10 mini tablets are filled in one 000 size gelatin capsule. HPMC: Hydroxy propyl methyl cellulose

was determined individually and collectively on a digital weighing balance. The average weight of one tablet was determined from the collective weight, and the percentage deviation for each tablet was calculated using the following formula:

% Deviation = (Individual tablet weight – Average weight of 20 tablets/Average weight of 20 tablets) × 100

Thickness test

Thickness of the tablets was determined by Vernier Calipers and screw gauge. Five tablets were taken and their thickness was recorded and the average thickness along with the standard deviation is reported.

Hardness test

The hardness of tablets was determined using Monsanto hardness tester. The hardness of 10 tablets was determined and the average is calculated and reported with the standard deviation. Hardness of the tablet is the force applied across the diameter of the tablet to break the tablet. The resistance of the tablet for chipping, breakage or abrasion under condition of storage, transformation, and handling before usage depends on the tablet hardness.

Friability test

From each batch, 20 tablets were selected randomly and weighed. In the Roche friabilator, each group of tablets was rotated at 25 rpm for 4 min (100 rotations). To determine the loss in weight the tablets were then dedusted and reweighed. Friability was then calculated as per weight loss from the original tablets.

$$\% \text{ Friability} = [(W_1 - W_2)/W_1] \times 100$$

Where, W_1 = Initial weight of 20 tablets,
W_2 = Weight of the 20 tablets after testing.

Drug content

About 20 tablets were taken, powdered and the powder equivalent to one dose was transferred to a 100 mL volumetric flask and 0.1 N Hcl was added. The volume was then made up to the mark with 0.1 N HCl. The solution was filtered and diluted suitably, and drug content in the samples was estimated using ultraviolet (UV)-visible spectrophotometer at max 292 nm.[8]

Table 2: Functional groups and range for pyridoxine HCl and optimized formulation of pyridoxine HCl

Functional groups	Pyridoxine HCl	Optimized formulation (FP8)
C=N	2899	2953
C=C	1700	1719

In vitro buoyancy studies

The *in-vitro* buoyancy was determined by floating lag time, as per the method described by Rosa *et al*., 1994. The tablets were placed in a 200 mL beaker containing 0.1 N HCl. The time required for the tablet to rise to the surface and to float was determined as floating lag time. The duration of time for which the dosage form constantly remained on the surface of medium was determined as the total floating time.[8,9]

In vitro drug release studies

The *in-vitro* drug release study was performed for all the tablets using USP Type II dissolution apparatus under the following conditions.

Dissolution test parameters

Medium: 900 mL of 0.1 N HCl
Rotation speed: 50 rpm
Temperature: 37 ± 0.5°C
Sampling volume: 5 mL
Sampling time: 0.5, 1, 2, 3, 4, 6, 8, 10 and 12 h

At predetermined time intervals, 5 mL of samples were collected and replenished with the same volume of fresh medium. The drug content in the samples was estimated using UV-Visible spectrophotometer at a λ_{max} of 292 nm.

Stability studies

To assess the drug and formulation stability, stability studies were done according to ICH and WHO guidelines.[10] Optimized formulation kept in the humidity chamber (Pooja Labs, India) maintained at 40°C and 75% relative humidity for 6 months. At the end of studies, samples were analyzed for physicochemical parameters. For the comparison of release profiles of initial and stability samples, "difference factor" f_1 and "similarity factor" f_2, were calculated. The difference factor (f_1) measures the percent error between the two curves over all time points and was calculated as follows.[11]

$$f_1 = \frac{\sum_{j-1}^{n} | R_j - R_j |}{\sum_{j-1}^{n} R_j}$$

Where, n is the number of sampling points, R_j and T_j are the percent dissolved of the reference and test products at each time point j. The two release profiles are considered to be similar if f_1 value is lower than 15 (between 0 and 15). The similarity factor (f_2) is a logarithmic transformation of the sum of squared error of differences between the test T_j and the reference products R_j over all time points. It was calculated using the following equation:

$$f_2 = 50 \log \left\{ \left[1 + \left(1/n\right)^{-0.5} \sum_{j-1}^{n} w_j |R_j - T_j| \right]^2 \right\} \times 100$$

Where, w_j is an optional weight factor and other terms are as defined earlier. The two dissolution profiles are considered to be similar if f_2 value is more than 50 (between 50 and 100).

Determination of *in-vivo* gastric residence time in human volunteers

The *in vivo* X-ray studies were approved by the Institutional Ethical Committee with approval No. IHEC/VGOPC/059/2015. Tablets were administered to healthy human volunteers (n = 3) aged between 20 and 25 years and weighing between 50 and 60 kg were selected for these studies. For these studies, optimized formulation was modified by replacing complete drug with X-ray grade barium sulfate which is a radio-opaque substance, keeping all other ingredients constant. The *in-vivo* gastric residence time determination was carried out under fed conditions.[12-14] In fed state, the capsule containing tablets was administered to the volunteers after taking a standard fat and protein breakfast with 200 mL of water and for every ½ h 200 mL of water was administered to the volunteer to help the tablet to float in the gastrointestinal contents.

RESULTS

Calibration curves of pyridoxine HCl

An UV-spectro-photometric method was used for estimation of pyridoxine HCl. A solution of pyridoxine HCl (10 µg/mL) was scanned in the wavelength range of 200-400 nm and found to have maximum absorption (λ_{max}) at 292 nm. The standard plot of pyridoxine HCl was prepared in 0.1 N HCl (pH 1.2). The standard graph showed good linearity with R^2 value of 0.9990.

Drug-excipient compatibility studies

The thermal behavior of pure drug and optimized formulation is compared in the FTIR spectrum. The characteristic peaks which are observed for the pure drug in the FTIR spectra were also observed for optimized formulation with little shifting of peaks (Figure 1) suggesting that there is no interaction between drug and excipients (Table 2).

Evaluation of physical parameters of floating mini tablets of pyridoxine HCl

All the prepared formulations were tested for physical parameters such as hardness, thickness, weight variation, friability, and assay were found to be within the pharmacopeial limits. Results of the physical tests were tabulated and shown in Table 3. The assay of all the formulations was evaluated and was found to be within the permissible limit.

The results of the physical tests of many of the formulations were in the limits and comply with the standards.

Floating properties of floating mini matrix tablets of pyridoxine HCl

All the formulations were tested for floating properties such as floating lag and total floating time. The results of the tests

Table 3: Physical parameters of floating mini tablets of pyridoxine HCl (mean±SD)

Formulation code	Weight variation (*n*=20)	Hardness (kg/cm²) (*n*=10)	Thickness (mm) (*n*=5)	Friability (%) (*n*=20)	Assay (%) (*n*=3)
FP1	50.28±1.12	4.15±0.01	4.12±0.04	0.14	99.23±1.21
FP2	48.99±1.15	4.11±0.05	4.05±0.03	0.15	100.12±1.05
FP3	49.78±1.12	4.20±0.02	4.06±0.06	0.18	99.82±1.22
FP4	50.35±1.10	4.15±0.02	4.02±0.05	0.15	99.98±1.05
FP5	50.57±1.15	4.18±0.01	4.18±0.02	0.17	99.43±1.13
FP6	50.11±1.12	4.15±0.03	3.97±0.03	0.15	99.67±1.21
FP7	49.74±1.01	4.17±0.05	4.10±0.04	0.16	98.89±1.02
FP8	49.03±1.14	4.23±0.05	3.98±0.07	0.18	100.23±0.96
FP9	50.87±1.13	4.11±0.05	3.88±0.05	0.19	99.95±1.17
FP10	50.29±1.10	4.06±0.09	4.11±0.02	0.16	101.10±0.95
FP11	48.11±1.11	4.18±0.08	3.95±0.04	0.18	98.88±1.65
FP12	49.87±1.10	4.14±0.01	4.02±0.03	0.17	100.14±1.02
FP13	51.12±1.06	4.08±0.07	3.99±0.06	0.14	100.01±0.90
FP14	49.05±1.15	4.21±0.02	4.20±0.02	0.13	98.99±1.56
FP15	50.22±1.14	4.16±0.06	4.10±0.04	0.14	101.21±0.88

SD: Standard deviation

were tabulated. All the batches showed good *in vitro* buoyancy. The floating lag time was found to be in the range of 15-26 s. Total floating time was observed in between 6 and 12 h. The results of the *in vitro* buoyancy study are shown in the Table 4.

In vitro drug release studies

The *in-vitro* drug release studies for multiple units prepared with HPMC K_4M and ethyl cellulose (Figure 2), FP1 released more than 90% of drug within 8 h whereas formulation FP2 to FP5 released 97.24%, 96.59%, 95.98%, and 92.52%, respectively, in 12 h. As FP4 released more drug than 90% of the drug up to 12 h with less floating lag time, hence FP4 was considered for optimization in the case of formulations prepared with HPMC K_4M and ethyl cellulose.

Table 4: Floating properties of floating mini matrix tablets of pyridoxine HCl

Formulation code	Floating Lag time(s) Mean±SD (*n*=3)	Total floating time (h)
FP1	15±2.35	6
FP2	18±1.75	8
FP3	18±2.36	10
FP4	20±3.45	>12
FP5	21±2.35	>12
FP6	17±3.26	8
FP7	16±2.18	10
FP8	16±2.54	>12
FP9	17±2.48	>12
FP10	21±2.25	12
FP11	24±2.38	10
FP12	23±2.27	11
FP13	26±3.49	>12
FP14	22±1.84	>12
FP15	24±1.75	>12

SD: Standard deviation

Formulations with HPMC $K_{15}M$ and ethyl cellulose (Figure 3), FP6 and FP7 released more than 90% of drug within 8-10 h whereas formulation FP8, FP9, and FP10 released 98.86%, 93.12%, and 89.46% respectively in 12 h. As FP8 released more drug than FP9 and FP10 and floating lag time of FP8 is less when compared to others. Hence, FP8 was considered as an optimized formulation in the case of formulations prepared with HPMC $K_{15}M$ and ethyl cellulose.

Formulations with HPMC K100M and ethyl cellulose (Figure 4), FP11and FP12 released more than 90% of drug within 10 h whereas formulation FP13, FP14, and FP15 released 90.19%, 88.11%, and 87.91%, respectively, in 12 h. As FP13 released more than 90% drug when compared to FP14 and FP15 with less floating lag time, hence it was considered as an optimized formulation in the case of formulations prepared with HPMC K100M and ethyl cellulose.

From the above observations, it is found that FP4, FP8, and FP13 formulations were considered for optimization and among these three formulations FP8 has shown less floating lag time and more *in-vitro* drug release compared to FP4 and FP13, hence it was considered as optimized formulation in case of multiple units and subjected to stability and X-ray studies.

Table 5: Regression coefficient (R^2) values of floating multiple unit matrix tablets for different kinetic models

Formulation code	R^2				Peppas (*n*)
	Zero	First	Higuchi	Korsmeyer–Peppas	
FP1	0.82	0.97	0.96	0.97	0.40
FP2	0.84	0.99	0.97	0.97	0.42
FP3	0.87	0.99	0.97	0.96	0.44
FP4	0.89	0.99	0.97	0.96	0.46
FP5	0.89	0.97	0.96	0.95	0.47
FP6	0.82	0.94	0.96	0.97	0.43
FP7	0.86	0.98	0.97	0.97	0.45
FP8	0.91	0.92	0.99	0.97	0.49
FP9	0.91	0.99	0.98	0.97	0.51
FP10	0.91	0.99	0.99	0.98	0.49
FP11	0.94	0.97	0.97	0.96	0.55
FP12	0.95	0.96	0.96	0.95	0.58
FP13	0.97	0.95	0.95	0.94	0.59
FP14	0.97	0.94	0.94	0.94	0.61
FP15	0.98	0.94	0.93	0.93	0.62

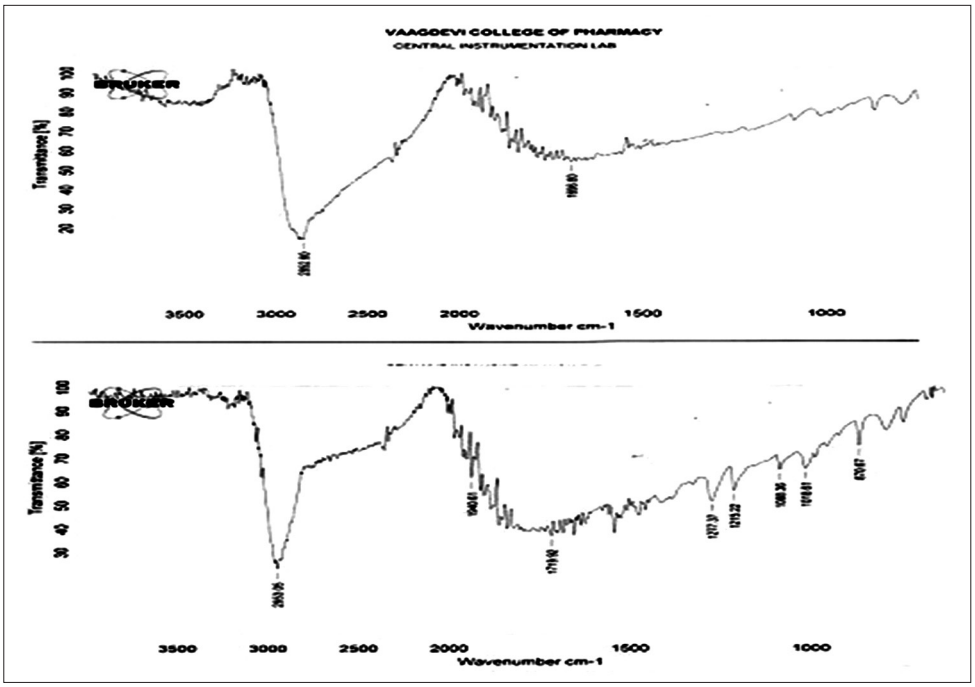

Figure 1: FT-IR spectrum of Pyridoxine HCl and optimized formulation of Pyridoxine HCl

Table 6: Stability study of optimized formulation (FP8) for floating mini matrix tablets of pyridoxine HCl (mean±SD)

Parameters observed during stability study	0 month	After 3 months	After 6 months
Assay % (*n*=3)	100.23±0.96	99.46±1.57	99.52±1.26
Floating lag time (s) (*n*=3)	16.24±2.54	17.84±1.96	17.28±2.16
Total floating time (h) (*n*=3)	>12	>12	>12

SD: Standard deviation

Table 7: Barium sulfate loaded multiple units evaluation parameters (mean±SD)

Parameters	Optimized batch (FP8)	Tablets containing $BaSO_4$
Hardness (kg/cm^2) (*n*=10)	4.23±0.05	4.41±0.25
Thickness (mm) (*n*=5)	3.98±0.05	3.72±0.02
Floating lag time (s) (*n*=3)	16±2.54	29±2.44
Total floating time (h)	>12	>12

SD: Standard deviation

Mathematical modeling of dissolution profiles

The correlation of coefficient (R^2) values for formulations FP1-FP12, the first order release kinetics was found to be higher when compared to that of zero order release kinetics indicating that drug release followed first order kinetics whereas FP13-FP15 followed zero order (Table 5).

The dissolution data were further characterized by fitting the data into Higuchi's square root time model. The correlation coefficient values of Higuchi plot of formulations FP1 to FP15 were found to be more than 0.93. As the correlation coefficient values are close to one, it indicates that the drug release is by diffusion mechanism.

When the log cumulative percent of drug released was plotted against time on log scale, the diffusional exponent values (*n*) were found to follow both Fickian diffusion(diffusion controlled) and non-Fickian diffusion (diffusion and erosion controlled), but the optimized formulation followed Fickian diffusion.

Stability studies

In view of the potential utility of the formulations, stability studies were carried out at 40°C ± 5°C/75% ± 5% RH for 6 months to assess their long-term stability. After storage, the optimized formulations were subjected to a drug assay, floating behavior, and *in vitro* dissolution studies.

The analysis of the dissolution data, of optimized formulation FP8 after storage at 40°C ± 5°C/75% ± 5% RH for 6 months showed, no significant change indicating the two dissolution profiles are considered to be similar (f_2 value was more than 50, i.e., 73.51 at 3rd month and 72.17 at 6th month and f_1 value <15, i.e., 5.45 at 3rd month and 5.69 at 6th month)

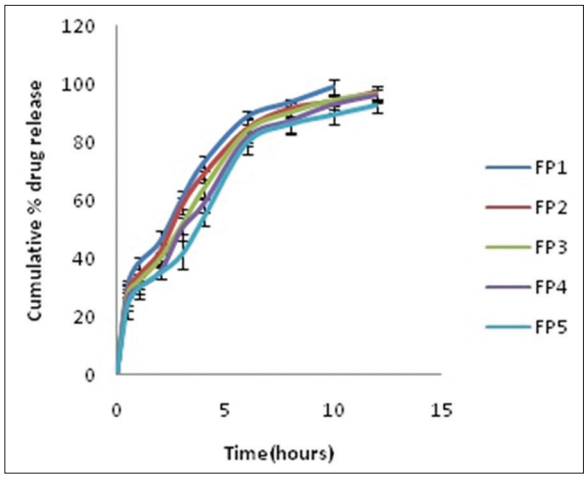

Figure 2: Cumulative percentage drug release of formulations with hydroxypropyl methyl cellulose K_4M and ethyl cellulose (mean ± standard deviation, *n* = 3)

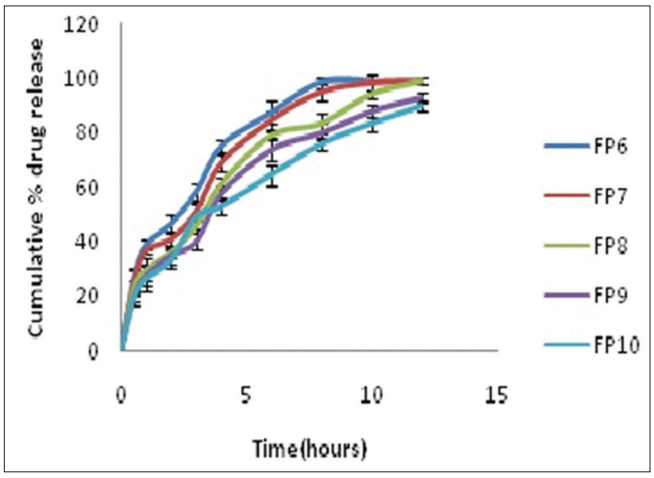

Figure 3: Cumulative percentage drug release of formulations with hydroxypropyl methyl cellulose $K_{15}M$ and ethyl cellulose (mean ± standard deviation, *n* = 3)

which indicate good similarity between dissolution profiles during stability period. The assay % and floating parameters after the stability period have not shown any much variations indicating good physical stability (Table 6).

In-vivo X-ray studies for floating multiple units of pyridoxine HCl

The prepared barium sulfate loaded multiple units were evaluated for the following parameters:

The analysis confirmed that these tablets were similar to the tablets for *in-vitro* testing, i.e., the mechanical strength and floating properties (Table 7).

The behavior of floating multiple units in the human volunteers was detected using X-ray technique. The X-ray images were taken at different time intervals after oral administration; the tablets were detected in the human

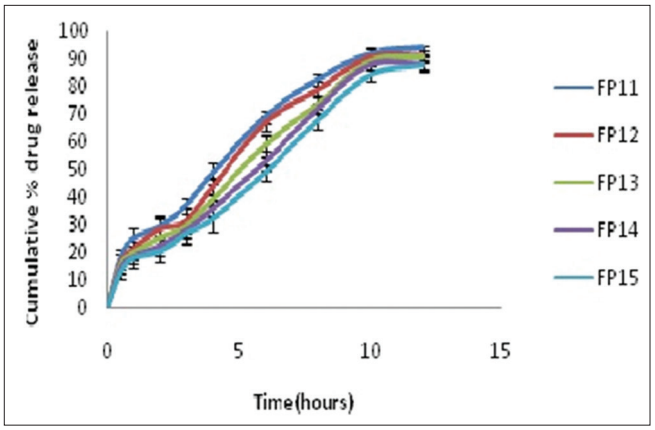

Figure 4: Cumulative percentage drug release of formulations with hydroxypropyl methyl cellulose $K_{100}M$ and ethyl cellulose (mean ± standard deviation, *n* = 3)

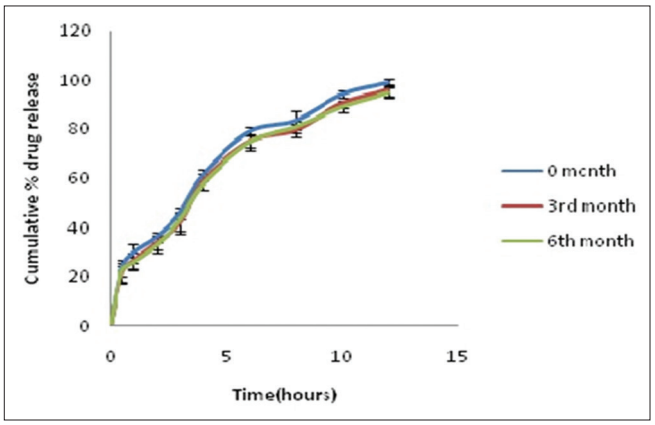

Figure 5: Cumulative percentage drug release of optimized formulation FP8 at 0, 3rd, 6th month (mean ± standard deviation, *n* = 3)

stomach after 30 min. The next pictures were taken at 2nd h, 4th h, and 6th h significant changes were observed. The tablet had altered its position in the stomach. This indicated the evidence that the tablets did not adhere to the gastric mucosa but floated on the gastric fluid and during 6th h only two or three tablets were observed in radiographic image (Figure 6). Hence, X-ray studies suggest that optimized floating multiple units could be retained in the stomach for up to 6 h.

DISCUSSION

In this research work, an attempt has been made to develop floating mini matrix tablets of pyridoxine HCl using HPMC grade polymers along with ethyl cellulose. Earlier Suresh and Roa and Lingam *et al*. reported the significance of HPMC grade polymers along with ethyl cellulose for controlling the release of drug from the multiple units. Based on the previous literature, we have developed the mini matrix tablets of pyridoxine HCl using HPMC grade polymers along with ethyl cellulose for controlling the release of drug from dosage form. The potential interaction between drug and excipients

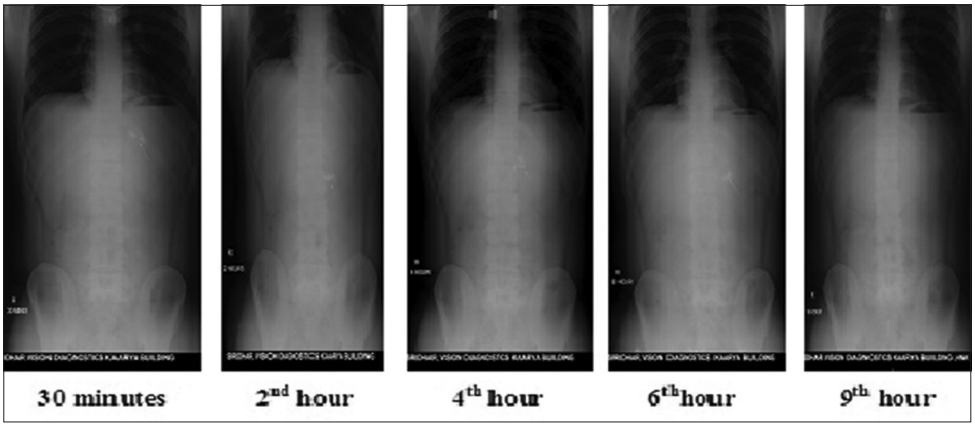

Figure 6: Radiographic pictures of human volunteers taken at different time intervals

was studied by FTIR spectroscopy which suggested that there is no chemical interaction between drug and excipients. The physical parameters such as thickness, hardness, weight variation, friability, and drug content were within the pharmacopeial limits indicating good physical stability. The *in-vitro* floating properties of mini matrix tablets were determined by the method described by Rosa *et al*., and all the formulations showed good *in vitro* buoyancy. When low concentration (2.5%) of effervescent agent was employed in the formulations, then the floating lag time was found to be high but when 7.5% of effervescent agent was utilized, tablets disintegrated and were unable to withstand up to 12 h. Only tablets which were formulated with 5% of effervescent agent were able to withstand up to 12 h with desired floating lag time and was chosen as optimum concentration. The *in-vitro* drug release studies of mini matrix made from various HPMC grade polymers showed a rapid drug release when they were formulated with low concentration of polymers and as the concentration of polymer was increased the drug release was reduced. In this investigation, tablets formulated with HPMC alone were unable to withstand up to 12 h and disintegrated so ethyl cellulose was incorporated in the formulations since it is insoluble in gastric fluids and sustained up to 12 h.

From the *in-vitro* observations, it was found that FP4, FP8, and FP13 formulations showed complete drug release and were considered for optimization. The drug release and floating lag time are important in the formulation of gastroretentive floating systems. The formulation with minimum floating lag time and drug release of more than 90% within 12 h was considered in the optimization of formulations. This criterion was fulfilled by FP8 formulation and it was considered as optimized formulation. The optimized formulation was further subjected to stability and X-ray studies.

Drug release kinetics indicated that drug release followed first order kinetics for most of the formulations except FP13-FP15 with diffusion-controlled mechanism. The stability studies for the optimized formulations were conducted as per the WHO and ICH guidelines, and the results suggested that the developed formulation is stable during the stability period. Previously Katakam *et al*. and Doodipala *et al*. and several others reported the radiographic studies in human volunteers for floating GRDDSs. Based on earlier reports, we have conducted the *in-vivo* radiographic studies which suggested the retention of mini matrix tablets was up to 6 h without any adhesion to the walls of stomach indicating that gastric retention is mainly due to floating behavior rather than mucoadhesion. Till now, very little work is reported for pyridoxine HCl considering it as a model drug for gastroretentive systems. The future scope of this investigation is to establish the pharmacokinetics of the drug by performing bioavailability study in the human volunteers.

CONCLUSION

It is concluded that the adopted method yielded uniform and reproducible new floating mini matrix tablets of pyridoxine HCl with HPMC grade and ethyl cellulose polymers. The *in-vitro* and *in-vivo* studies showed that the optimized formulation (FP8) could be successfully formulated as gastroretentive dosage form for pyridoxine HCl.

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