Lansoprazole Release from a Floating Dosage Form based on the Natural Polymer of Delonix regia

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Abstract: The objective of this present investigation is related with exploitation of Delonix regia seed polysaccharide (DRSP) as an excipient and comparison of combination of natural and synthetic polymer for better sustained effect in floating drug delivery systems. This objective motivates for developing newer natural excipient and exploits the present limitation in terms of toxicity, compatibility and cost effectiveness. Present study aimed at development and characterization of sustained release matrix tablet of lansoprazole prepared by wet granulation method. The matrix tablets of lansoprazole were evaluated in terms of their precompression parameters, physical characteristics, in vitro release, buoyancy lag-time and total floating time. The results of the in vitro release studies showed that the optimized formulation F8 (natural polymer) could sustain drug release (98.74 %) for 24 hrs and remain buoyant for more than 24 hrs. The drug release was decreased with the increase in DRSP concentration and with the addition of ethylcellulose. The drug release was observed by non-fickian diffusion mechanism. The release kinetics of the formulation F1 and F2 (synthetic polymer) showed more release in 6hrs and 12hrs as compared to F7 and F8 (natural polymer). Drug release kinetics was explained by Higuchi’s equation, as the plots showed the highest linearity, but a close relationship was also noted with zero-order kinetics. The optimized formulation was also subjected for stability testing and was found to have good stability with no appreciable drug degradation. Hence, it was found to be a better combination for the formulation of sustained release matrix tablets of lansoprazole.

Key words: Lansoprazole, Delonix regia, Buoyancy, gastroretentive, sustained release.

Introduction

In recent years, oral dosage forms for gastric retention have drawn more and more attention for their theoretical advantages in permitting control over the time and site of drug release.1 Floating drug delivery system is one of the approaches to increase the gastric residence time of the drug. The brief gastric emptying time in humans (2-3hrs through the major absorption zone - stomach or upper part of the intestine) can result in incomplete drug release from the drug delivery system leading to diminished efficacy of the administered dose. Thus, placement of the drug delivery system in a specific region of the gastrointestinal tract offers numerous advantages, especially to the drugs having narrow absorption window in the gastrointestinal tract, primary absorption in the stomach, stability problem in intestine, poor solubility at alkaline pH, local activity in stomach and property to degrade in
Materials and Methods:

Isolation of the gum from seeds of Delonix regia

The pods of Delonix regia, family-Fabaceae were collected and these pods were imbibed in the water for an overnight to separate the seeds from the pods. The seeds mainly contain the three parts seed kernel, endosperm, and dicotyledon. The seeds (500 g) were boiled in the distilled water for 3 h until the seed kernels were swelled which was then removed by the hands. The gum part was separated from the yellow dicotyledons. The gum portion was dried in an oven at 45°C for 12 h and then was grounded in the multimill. The resulting powder was passed through 60 # sieve.

Solubility studies

Exactly weighed amounts of drug was repeatedly added to solubility bottles each containing fixed quantity of 0.1N HCl, 6.8 phosphate buffer, and distilled water until the solvent gets saturated. The suspension was agitated at 37 ± 0.5°C for 24 hrs. Aliquots were withdrawn from the suspensions and passed through millipore filter. The concentration of the drug in each solvent filtrate was analyzed using UV-Visible spectrophotometer (Perkin Elmer, Massachusetts, USA) at 280 nm The solubility study for each solvent was carried out in triplicate.

Preparation of Lansoprazole floating tablet:

The composition of different formulations of lansoprazole floating tablets is shown in Table 1. Each floating tablets containing 300mg lansoprazole were prepared by a conventional wet granulation method, employing sodium bicarbonate, citric acid as gas generating agent and water-soluble and insoluble polymer (HPMC K4M and Ethyl cellulose, DRSP) used in combination. The ingredients were weighed accurately and mixed thoroughly. Granulation was done with a solution of PVP K-30 in sufficient isopropyl alcohol. The granules (40 mesh) were dried in conventional hot air oven at 350C±0.50C. The dried granules mixed with magnesium stearate as lubricant, t alc as glidant and compressed into tablet (8mm) on 10 station tablet punching machine (Cadmach, Ahmedabad). Prior to compression, granules were evaluated fortheir flow and compressibility characteristics.

Drug Polymer Compatibility studies

Fourier Transform Infra-Red Spectroscopy (FTIR)

The pure drug and physical mixture of drug and polymers were subjected to IR spectroscopic study using FT-IR spectrophotometer (IRAfinity-1, Shimadzu). The spectra were scanned over the wave number range from 4000 – 400 cm-1.
Differential Scanning Calorimetry (DSC)

DSC measurements were performed using Mettler Toledo Star 821e (Switzerland). The samples of pure drug and physical mixture of drug and polymers (5-10mg) were hermetically sealed in aluminum pans and heated at a constant rate of 20 °C/min over a temperature range of 25–200°C. An inert atmosphere was maintained by purging with nitrogen gas at a flow rate of 20 ml/min.

Evaluation of blend:

Angle of Repose

Angle of Repose of granules was determined by the funnel method. Accurately weighed powder blend were taken in the funnel. Height of the funnel was adjusted in such a way the tip of the funnel just touched the apex of the powder blend. Powder blend was allowed to flow through the funnel freely on to the surface. Diameter of the powder cone was measured and angle of repose was calculated using the following equation:

\[ \tan \alpha = \frac{h}{r} \]

Density

a) Bulk density (BD): Weigh accurately 25 g of granules, which was previously passed through 22# sieve and transferred in 100 ml graduated cylinder. Carefully level the powder without compacting, and read the unsettled apparent volume. Calculate the apparent bulk density in gm/ml by the following formula:

\[ \text{Bulk density} = \frac{\text{Weigh of powder}}{\text{Bulk volume}} \]

b) Tapped density (TD): Weigh accurately 25 g of granules, which was previously passed through 22# sieve and transferred in 100 ml graduated cylinder of tap density tester which was operated for fixed number of taps until the powder bed volume has reached a minimum, thus was calculated by formula:

\[ \text{Tapped density} = \frac{\text{Weigh of powder}}{\text{Tapped volume}} \]

Carr’s Index

Compressibility index of the powder blend was determined by Carr’s compressibility index. It is a simple test to evaluate the BD and TD of a powder and the rate at which its packed down. The formula for Carr’s index is as below:

\[ \text{Carr's index} = \frac{(\text{Tapped density} - \text{Bulk density})}{\text{Tapped density}} \times 100 \]

Hausner’s Ratio

Hausner’s Ratio is a number that is correlated to the flowability of a powder.

\[ \text{Hausner’s Ratio} = \frac{\text{Tapped density}}{\text{Bulk density}} \]

Evaluation of Tablets:

Thickness:

Thickness of the tablets was determined using a vernier caliper (For-bro engineers, Mumbai, India).

Weight Variation Test

20 tablets of each formulation were weighed using an electronic balance and the average weight was calculated and compared with the weight of each tablet. The tolerance in weight variation was allowed according to IP 1996.

Hardness

The tablets to be tested are held between a fixed and a moving jaw of hardness test apparatus (Monsanto) and reading of the indicator is adjusted to zero. The screw knob was moved forward until the tablet breaks and the force required breaking the tablet was noted.

Friability

Ten tablets were weighed and placed in the Roche friabilator test apparatus (Electrolab, Mumbai). The tablets were exposed to rolling and repeated shocks, resulting from free falls within the apparatus. After 100 revolutions, the tablets were reweighed. The friability was determined using following formula:

\[ \% \text{ friability} = \frac{\text{weight of the tablet after test}}{\text{weight of the tablet before test}} \times 100 \]

Drug Content Estimation

The drug content in each formulation was determined by triturating 20 tablets and powder equivalent to average weight was added in 100 ml of 0.1N hydrochloric acid, followed by stirring. The solution was filtered through a 0.45 membrane filter, diluted suitably and the absorbance of resultant solution was measured spectrophotometrically at 280 nm using 0.1M hydrochloric acid as blank.

In Vitro Buoyancy Studies

The time taken for tablet to emerge on surface of medium is called the floating lag time (FLT) and
duration of time the dosage form to constantly
remain on surface of medium is called the total
floating time (TFT). The in vitro buoyancy was
determined by floating lag time, per the method
described by Rosa et al. The tablets were placed in a
250-mL beaker containing 0.1N HCl. The time
required for the tablet to rise to the surface and float
was determined as floating lag time.16

**Swelling Characteristics (Water Uptake Study)**
The swelling properties were determined by placing
the tablet in the dissolution test apparatus, in 900 ml
of 0.1N HCl at 0 37± 0.5°C. The tablets were
removed periodically from dissolution medium.
After draining free from water by blotting paper,
these were measured for weight gain. Swelling
characteristics were expressed in terms of
percentage water uptake (WU %) show relationship
between swelling index and time.17

\[
WU \% = \frac{\text{[Weight of swollen tablet – Initial weight of the tablet]}}{\text{Initial weight of the tablet}} \times 100
\]

**In Vitro Dissolution Studies**
The release rate of lansoprazole from floating tablets
was determined using United States Pharmacopeia
(USP) Dissolution Testing Apparatus 2 (paddle
method). The dissolution test was performed using
900 ml of 0.1N hydrochloric acid, at 37 ± 0.5°C and
50 rpm. A sample (10 ml) of the solution was
withdrawn from the dissolution apparatus hourly and
the samples were replaced with fresh dissolution
medium. The samples were filtered through a 0.45
membrane filter and diluted to a suitable
concentration with 0.1N hydrochloric acid. Absorbance of these solutions was measured at 280
nm using a UV/Visible spectrophotometer. The
percentage drug release was plotted against time to
determine the release profile.

**In Vitro Drug Release Kinetic Studies**
Kinetic model had described drug dissolution from
solid dosage form where the dissolved amount of
drug is a function of test time. In order to study the
exact mechanism of drug release from the tablets,
drug release data was analyzed according to zero
order18, first order19, Higuchi square root20,
Korsmeyer- Peppas model21. The criteria for
selecting the most appropriate
model was chosen on the basis of goodness of fit
test. The data were processed for regression analysis
using graph pad prism

**Stability Study of Optimized Formulation (F8)**
The optimized floating tablets (F8) were selected for
stability study on the basis of in vitro buoyancy and in vitro drug dissolution studies. The tablets were
investigated at 40°C/75% RH for 3 months. From
the data, the formulation is found to be stable under
the conditions mentioned before since there was no
significant change in the percentage amount of drug
content (Table 6). Thus, it was found that the
floating tablets of lansoprazole (F8) were stable
under these storage conditions for at least 3 months.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
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<td>10</td>
<td>10</td>
<td>10</td>
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<td>Delonix regia seed polymer</td>
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<td>1</td>
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<td>Mg Stearate</td>
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<td>Lactose</td>
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Table 2: Pre-Compression Evaluation of Lansoprazole Floating tablets

<table>
<thead>
<tr>
<th>Formulation Code</th>
<th>Angle of Repose (°) ±S.D</th>
<th>Bulk density (g/cm³) ±S.D</th>
<th>Tapped density* (g/cm³) ±S.D</th>
<th>Carr’s Index ±S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>23.71 ±0.51</td>
<td>0.486 ±0.011</td>
<td>0.562 ±0.041</td>
<td>13.58 ±0.72</td>
</tr>
<tr>
<td>F2</td>
<td>21.52 ±0.59</td>
<td>0.468 ±0.005</td>
<td>0.564 ±0.013</td>
<td>15.29 ±0.56</td>
</tr>
<tr>
<td>F3</td>
<td>25.32 ±0.38</td>
<td>0.483 ±0.114</td>
<td>0.569 ±0.096</td>
<td>16.72 ±0.32</td>
</tr>
<tr>
<td>F4</td>
<td>26.42 ±0.72</td>
<td>0.446 ±0.032</td>
<td>0.567 ±0.038</td>
<td>17.60 ±0.27</td>
</tr>
<tr>
<td>F5</td>
<td>22.56 ±0.21</td>
<td>0.442 ±0.014</td>
<td>0.521 ±0.025</td>
<td>15.64 ±0.13</td>
</tr>
<tr>
<td>F6</td>
<td>24.75 ±0.34</td>
<td>0.453 ±0.147</td>
<td>0.534 ±0.12</td>
<td>17.26 ±0.24</td>
</tr>
<tr>
<td>F7</td>
<td>22.79 ±0.51</td>
<td>0.592 ±0.025</td>
<td>0.547 ±0.016</td>
<td>17.18 ±0.56</td>
</tr>
<tr>
<td>F8</td>
<td>25.29 ±0.12</td>
<td>0.614 ±0.071</td>
<td>0.549 ±0.052</td>
<td>19.16 ±0.92</td>
</tr>
</tbody>
</table>

Table 3: Post Compression Evaluation of Lansoprazole Floating tablets

<table>
<thead>
<tr>
<th>Formulation Code</th>
<th>Thickness (mm) ±S.D</th>
<th>Hardness (Kg/cm²) ±S.D</th>
<th>Friability (%) ±S.D</th>
<th>Weight variation (mg) ±S.D</th>
<th>Drug content (%) ±S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>4.1 ±0.01</td>
<td>4.5 ±0.03</td>
<td>0.82 ±0.04</td>
<td>0.298 ±0.511</td>
<td>95.34 ±0.005</td>
</tr>
<tr>
<td>F2</td>
<td>4.2 ±0.05</td>
<td>4.7 ±0.02</td>
<td>0.86 ±0.06</td>
<td>0.297 ±0.010</td>
<td>96.29 ±0.008</td>
</tr>
<tr>
<td>F3</td>
<td>4.29 ±0.03</td>
<td>4.2 ±0.02</td>
<td>0.69 ±0.02</td>
<td>0.299 ±0.024</td>
<td>97.36 ±0.021</td>
</tr>
<tr>
<td>F4</td>
<td>4.32 ±0.04</td>
<td>4.4 ±0.04</td>
<td>0.67 ±0.07</td>
<td>0.301 ±0.521</td>
<td>98.47 ±0.012</td>
</tr>
<tr>
<td>F5</td>
<td>4.53 ±0.05</td>
<td>5.0 ±0.01</td>
<td>0.71 ±0.01</td>
<td>0.296 ±0.011</td>
<td>98.65 ±0.014</td>
</tr>
<tr>
<td>F6</td>
<td>4.26 ±0.04</td>
<td>4.7 ±0.02</td>
<td>0.76 ±0.04</td>
<td>0.297 ±0.041</td>
<td>97.84 ±0.005</td>
</tr>
<tr>
<td>F7</td>
<td>4.32 ±0.01</td>
<td>4.9 ±0.04</td>
<td>0.85 ±0.02</td>
<td>0.300 ±0.001</td>
<td>98.64 ±0.006</td>
</tr>
<tr>
<td>F8</td>
<td>4.30 ±0.04</td>
<td>4.8 ±0.02</td>
<td>0.68 ±0.07</td>
<td>0.298 ±0.012</td>
<td>99.67 ±0.008</td>
</tr>
</tbody>
</table>

Table 4: Results of Invitro Buoyancy studies of Lansoprazole floating Tablets

<table>
<thead>
<tr>
<th>Formulation code</th>
<th>Floating Lag Time (Seconds)</th>
<th>Total Floating Time (hours)</th>
<th>Swelling Index (%) (After 24 hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>240.33 ±1.52</td>
<td>6</td>
<td>55</td>
</tr>
<tr>
<td>F2</td>
<td>180 ±1.0</td>
<td>12</td>
<td>73.23</td>
</tr>
<tr>
<td>F3</td>
<td>60.66 ±0.52</td>
<td>18</td>
<td>76.91</td>
</tr>
<tr>
<td>F4</td>
<td>80.21 ±2.08</td>
<td>20</td>
<td>81.46</td>
</tr>
<tr>
<td>F5</td>
<td>210.24 ±2.0</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>F6</td>
<td>105.10 ±0.57</td>
<td>16</td>
<td>77.24</td>
</tr>
<tr>
<td>F7</td>
<td>120.12 ±0.64</td>
<td>22</td>
<td>82.79</td>
</tr>
<tr>
<td>F8</td>
<td>80.23 ±0.36</td>
<td>24</td>
<td>96.42</td>
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</table>

Table 5: Kinetics release data of different model for optimized formulation F8

<table>
<thead>
<tr>
<th>Optimized Formulation code</th>
<th>% Cumulative drug release</th>
<th>Zero order R²</th>
<th>First order R²</th>
<th>Higuchi Kinetics R²</th>
<th>Peppas Equation R²</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>F8</td>
<td>98.74</td>
<td>0.969</td>
<td>0.872</td>
<td>0.971</td>
<td>0.992</td>
<td>0.8013</td>
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</table>
Table 6: Stability study (40 C / 75% RH) of Optimized Formulation (F8)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>1st Month</th>
<th>2nd Month</th>
<th>3rd Month</th>
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</thead>
<tbody>
<tr>
<td>Physical appearance</td>
<td>Off white flat smooth faced</td>
<td>Off white flat smooth faced</td>
<td>Off white flat smooth faced</td>
</tr>
<tr>
<td>Weight Variation (mg)</td>
<td>0.298 ±0.012</td>
<td>0.298 ±0.012</td>
<td>0.298 ±0.012</td>
</tr>
<tr>
<td>Hardness (Kg/cm$^2$)</td>
<td>4.8 ±0.02</td>
<td>4.7 ±0.02</td>
<td>4.7 ±0.02</td>
</tr>
<tr>
<td>Drug Content (%)</td>
<td>99.67 ±0.008</td>
<td>98.34 ± 0.23</td>
<td>97.76 ±0.006</td>
</tr>
<tr>
<td>Friability (%)</td>
<td>0.68 ±0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buoyancy Lag Time (s)</td>
<td>80.23 ±0.36</td>
<td>82.54 ± 0.45</td>
<td>84.34 ±0.12</td>
</tr>
<tr>
<td>Total floating time in hours</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Buoyancy on disturbing</td>
<td>Float</td>
<td>Float</td>
<td>Float</td>
</tr>
<tr>
<td>In vitro release (%)</td>
<td>98.74 ±0.45</td>
<td>97.37 ± 0.89</td>
<td>96.23 ±0.74</td>
</tr>
</tbody>
</table>

Results and discussion

The pre-formulation studies were performed for the active pharmaceutical ingredient (API) to assess its formulation suitability. The solubility study data for the drug showed low solubility in acidic conditions (5.27 g/ml) than water (48.65 g/ml) and phosphate buffer pH 6.8 (87.95 g/ml). The effervescent floating tablets of lansoprazole were formulated to make a comparative evaluation of natural and synthetic polymer with HPMC K4M in two different batches (F1 to F4) by using combination of (HPMC K4M and Ethylcellulose), F5 to F8 (HPMC K4M and DRSP polymer) along with effervescing agent sodium bicarbonate and citric acid. It was found that Ethylcellulose has a negative effect on floating behavior for long duration but it showed drug release retardant characteristics. All the formulations were prepared by wet granulation method. The DRSP polymer exhibited excellent release retarding properties in matrix tablets for sustained release. Floating tablets of lansoprazole were designed in the present study to enhance its oral bioavailability and to achieve sustained release over 24 h for once-a-day administration.

Compatibility studies of lansoprazole: FTIR Studies

Drug- excipient interactions play a vital role with respect to release of drug from the formulation amongst others. FTIR techniques have been used here to study the physical and chemical interaction between drug and excipients used. In the present study, it has been observed that there is no chemical interaction between lansoprazole and the polymers used. Form the figure 1A it was observed that there were no changes in these main peaks in IR spectra of mixture of drug and polymers, which show there were no physical interactions. The characteristic absorption peaks of Lansoprazole appeared at 3235.54, 2984.23 & 2930.31, 1580.38, 1282.39, 1118.51 denoting stretching vibration of –NH-, -CH2, aromatic ring, C-O and ether bond, respectively. IR peaks observed in physical mixture of lansoprazole and Delonix regia seed polymer were -CH2 (2984.23 & 2930.31),C=O (1580.24) C-O (1118), -NH- (3237.5). IR peaks observed in physical mixture of lansoprazole, Delonix regia and HPMC K4M100 were CH2 (2984.23 & 2930.31), C=O (1580.24), C-O (1118.2), NH (3339.32). There were no extra peaks were observed. Thus the chosen natural gums compatible with lansoprazole.
FIGURE 1A: FT-IR Spectrum of (A) lansoprazole, mixture of (B) lansoprazole and delonix regia seed powder and (C) physical mixture of lansoprasole, delonix regia seed powder and HPMC K4M 100

Differential Scanning Calorimetry (DSC)

Thermal behavior of pure Lansoprazole, delonix regia seed polymer and physical mixture of lansoprazole, DRSP and HPMCK4100M prepared are depicted in Fig. 1B. The pure LSP showed melting endothermic peak at 184.09 °C indicating crystalline nature of Lansoprazole, followed by exothermic peak which may be due to decomposition of Lansoprazole. The DSC thermogram of DRSP showed an endothermic peak at 87.37 °C indicating the glass transition temperature (Tg) of the polymer. The endothermic peak for the drug in physical mixture, showed minor changes in the melting endotherm of drug could be due to the mixing of drug and excipients, which lower the purity of each component in the mixture and may not necessarily indicates potential incompatibility.

Fig 1B: DSC Thermal Analysis of (A) lansoprazole, (B) Delonix regia seed polymer, (C) Physical mixture of Lansoprazole, Delonix regia and HPMC K4 100, (D) Physical mixture of Lansoprazole, Ethyl cellulose and HPMC K4 100, (E) Physical mixture of lansoprazole and Delonix regia seed polymer

Precompression Parameters of lansoprazole Granules

The formulations showed good flow property and compressibility index (Table 2). Angle of repose ranged from 21.52 ±0.59 to 26.42 ± 0.72 and the compressibility index ranged from 13.58 ± 0.72 to 19.16 ± 0.92. The LBD and TBD of the prepared granules ranged from 0.442 ± 0.014 to 0.614 ± 0.071 and 0.521 ± 0.025 to 0.569 ± 0.096 respectively. The results of angle of repose indicates good flow property of the granules and the value of compressibility index further showed support for the good flow property.

Post Compression Parameters of lansoprazole Floating Tablets

The shape of the tablets of all formulations remained off white, smooth, flat faced circular with no visible cracks. The thickness and diameter of tablets was measured by Vernier calipers and ranged between 4.10 ± 0.01 to 4.53 ± 0.05 mm, respectively. The hardness of the tablets was measured by Pfizer tester (Biological museum, Mumbai, India) and was in between 4.2 ± 0.02 to 5.0 ± 0.01 kg/cm2. The friability was measured by Friabilator (Thermonic, Campbell Electronics, Mumbai) and was found to be
0.67 ± 0.07 to 0.8 6± 0.06%, which is an indication of satisfactory mechanical resistance of the tablets as shown in (Table3). The drug content estimations showed values in the range of 95.34 ± 0.005 to 99.6 7± 0.008% as shown in (Table 3) which reflects good uniformity in drug content among different formulations. All the formulations showed values within the prescribed limits for tests like hardness, friability and weight variation which indicate that the prepared tablets are of standard quality.

6.5 In Vitro Release Studies

In vitro dissolution studies of all the formulations of floating tablets of lansoprazole were carried out in 0.1N HCl. The study was performed for 24hrs and cumulative drug release was calculated at every one hour time interval. It was observed that the type of natural polymer(DRSP) influences the drug release pattern. All the formulations contained equal amount of gas generating agent (sodium bi carbonate) and citric acid. All Batches were evaluated for the cumulative drug release. From the dissolution study of batch F1 to F8, it was concluded that release from the matrix is largely dependent on the polymer swelling, drug diffusion and matrix erosion. From in vitro dissolution profile, the batches (F1 to F4) prepared with different concentration of polymers (HPMC K4 and EC), formulation F1 showed 96.35±1.12 cumulative % drug release and floated for 6hrs, F2 showed 92.47±1.11 cumulative % drug release at 12 hrs. and formulation F3 showed 94.26.13±1.02 cumulative % drug release at 18 hrs, F4 showed 90.56±1.32 cumulative% drug release at 20 hrs. Increase in concentration of HPMC may result in increase in the tortuosity or gel strength of the polymer. From in–vitro dissolution profile of batches (F5 to F8) prepared with different concentration of (HPMC K4 and DRSP) showed a stronger retardation of drug release compared to synthetic polymers. The drug release from formulation F5 showed 92.75±1.44 cumulative % drug release at 8 hrs. and formulation F6 showed 90..72±1.62 cumulative % drug release at 16 hrs, formulation F7 showed 93..76±1.62 cumulative % drug release at 2 hrs, formulation F8 showed 98..74±1.62 cumulative % drug release and sustained for more than 24 hrs, a significantly higher rate and extent of drug release was observed from the batches based on synthetic polymers. Varying the amount of natural polymer affect the drug release. Drug release from natural polymer was less owing to its high viscosity and also due to less permeability of water to DRSP. More over synthetic polymers containing tablets F1-F4 could not bear their matrix shape until 12 h and the released the drug before 12 hrs. Tablets F5-F8 containing natural polymer (DRSP) in the increasing concentration, F8 was found to sustain drug release more than 24 hrs shown in fig.2.

It was observed that the drug release was slower from formulations containing natural polymer as compared to synthetic polymers. This may be due to hydrophobic nature of natural polymer, which restrict the penetration of medium inside the matrix and also restrict the formation of gel layer around

In Vitro Buoyancy Studies

All the tablets were prepared by effervescent approach. Sodium bicarbonate was added as a gas-generating agent. Sodium bicarbonate induced carbon dioxide generation in presence of dissolution medium (0.1 M hydrochloric acid). The combination of sodium bicarbonate and citric acid provided desired floating ability and therefore this combination was selected for the formulation of the floating tablets. It was observed that the gas generated is trapped and protected within the gel, formed by hydration of polymer (HPMC), thus decreasing the density of the tablet below 1 and tablet becomes buoyant. The tablet swelled radially and axially during in vitro buoyancy studies. In this study, penetration of water into tablets prepared with synthetic polymer combination was rather slow, causing delayed gel formation and subsequent decrease in the floating lag time compared to the tablets prepared with natural polymer combination. (Table 4).

The floating tablets of lansoprazole with the synthetic polymer (EC) showed better floating lag time 60.66 second(F3), (80.21 sec.(F4) and it floated for 18hrs and 20hrs, and formulation with natural polymers (DRSP) showed more floating lag time (80.23 sec.(F8), 120.12 (F7)sec. but floated more than 24hrs and 22 hrs.

Swelling index:
The swelling index was calculated with respect to time. As time increase, the swelling index was increased, because weight gain by tablet was increased proportionally with rate of hydration. Later on, it decreased gradually due to dissolution of outermost gelled layer of tablet into dissolution medium. The direct relationship was observed between swelling index and HPMC (K4M) concentration, ethyl cellulose and DRSP concentration increase, swelling index was increased.
the matrix as compared to the hydrophilic HPMC. When the polymer concentration was increased, the drug release rate was found to decrease. This is due to the reason that the swelling degree is less because of higher concentration of polymers.

Among all the formulations formulation F8 showed a constant rate of drug release in a sustained manner similar to zero order kinetics with good buoyancy property. (Fig 3, 4, 5 & 6 and Table 5). Hence F8 was chosen as the best formulation.

Stability studies of optimized formulation were performed at normal, intermediate and accelerated conditions. The data are shown in Table 6. It was found that formulation placed at 25°C show very less amount of drug loss, which indicates that formulation is more stable at room temperature.
Conclusion:
This study discusses the preparation of gastroretentive tablets of Lansoprazole. The addition of gel-forming polymer HPMC K4M, natural polymer and gas-generating agent sodium bicarbonate was essential to achieve in vitro buoyancy. The in vitro release of the formulation F1 and F2 showed more drug release as compared to F7 and F8 (natural polymer) shows better sustained release properties than synthetic polymer. From the results of the sustained release properties, it can be concluded that the natural novel polymeric material from Delonix regia may be natural and economical alternative for the formulation of floating drug delivery system.

Since Delonix regia gum is of natural origin it is non-toxic, biocompatible and cheaper. Now a day’s person prefers plant based medicines over synthetic medication for the treatment of different disease because of their safety as well as economy. However, extensive in vitro and in vivo study needs to be performed to support the hypothesis.

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