



## Gastro retentive film of famotidine using bio-material extracted from *Sapindus mukrossi* fruit pulp

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### Abstract

The present work was based on the development and characterization of gastro retentive dosage form appropriate for controlled release of Famotidine, a drug with narrow therapeutic window. The drug loaded polymer film of biological macromolecules (*Sapindus mukrossi*) was folded into hard gelatin capsules. The polymeric film revealed a fast release during the first hour followed by a more gradual drug release during a 12-h period following a non-Fickian diffusion process. Tensile strength of polymeric film was optimized using different amount (0.2–0.7 ml) of polyethylene glycol (PEG 400). Various physical parameters were studied for evaluating their performance as a gastroretentive dosage form. Drug and polymers were found to be compatible as revealed by interaction study and scanning electron microscopy (SEM) study revealed uniform dispersion of Famotidine in polymeric matrices. The results indicate that gastro retentive film drug delivery system holds lots of potential for drug having stability problems in alkaline pH or are which mainly absorbed in acidic pH.

**Key Words:** Gastro retentive film, Natural gum, Mucoadhesive film, *Sapindus mukrossi*, Famotidine

### Introduction

The development of an oral controlled release formulation has an incredible impact on the drug delivery area especially for the drugs with a narrow absorption window but the limitation of this approach is insufficient retention of drug in the stomach (Uttam *et al.*, 2016; Arora *et al.*, 2005; Singh *et al.*, 2000; Sathish *et al.*, 2013). In order to overcome this limitation, a number of strategies including, floating drug delivery system, mucoadhesives, co-administration of agents that alter the gastric motility have been developed (Sathish *et al.*, 2013; Deshpande *et al.*, 1997). Other approaches and drug carriers have been designed which unfold or expand in the stomach to form a

complex geometric shape to obstruct its escape through the pyloric sphincter (Klausner *et al.*, 2003; Klausner *et al.*, 2003; Klausner *et al.*, 2002). Combination of floating with the ability to expand by unfolding and swelling using blend of biodegradable polymers (hydrophilic and hydrophobic) is an alternative strategy to increase gastric residence time (Huwajj *et al.*, 2011; Rajamma *et al.*, 2012; Korsmeyer *et al.*, 1983; Freny *et al.*, 2013). The aim of the present work was to develop innovative gastro retentive formulation based on drug loaded polymeric film folded in hard gelatin capsule. The capsule dissolves after ingestion and release the film which then unfolds and the swelling usually results by osmotic absorption of gastric fluid to a larger dimension resulting in its increased retention (Shakuntla *et al.*, 2014). Based on this hypothesis, the mucoadhesive films were designed in such a way that they should be retained in the stomach for a prolonged period of time, thus maximizing the exposure of the drug to its absorption site (Peesh, *et al.*, 2016; Perioli *et al.*, 2004; Nafee *et al.*, 2004).

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Famotidine is a histamine H<sub>2</sub> receptor antagonist that inhibits stomach acid production. It is commonly used in the treatment of peptic ulcer disease and gastroesophageal reflux disease. Famotidine is a Biopharmaceutical Classification System (BCS) Class III drug with high solubility and poor permeability. It is mainly absorbed in the upper gastrointestinal tract and has a short half-life of 2.5–3.5 hours (Nafeet *et al.*, 2004; Deborah *et al.*, 1986). The present work is based on practical aspects of designing Mucoadhesive polymeric films which deliver immediate release (IR) to achieve the therapeutic drug concentration in a short period of time and controlled release to maintain the concentration for the desired period of time and provide optimal drug release in upper gastrointestinal tract (Barbara *et al.*, 1985).

### Materials and Method

Famotidine was generously gifted by Kwality pharma Pvt. Ltd., Amritsar, Punjab, India. All other reagents and chemicals were of suitable analytical grade and were used as received.

### Isolation of bio-material from *Sapindus mukorossi* fruits pulp:

For the isolation of mucilage, the fruits were washed properly with distilled water to remove any dust particles. Pulp of fruits was peeled off from the fruits and was sliced into small pieces and soaked in distilled water for 24 h. The soaked Pulp of fruits

was further ground in a grinder and kept for 24h for the release of mucilage. The material was squeezed through 8 fold muslin cloth to separate the marc from filtrate. Then acetone was added to the filtrate in a ratio (1:2) to precipitate the mucilage. The mucilage was separated and dehydrated in hot air oven at 40°C, crushed and passed through British standard Sieve (BSS) no. 80 (Mesh size 180 µm). The reddish brown powder was kept in a desiccator until further use (Vipulet *et al.*, 2013).

### Preparation of polymer film

The polymer film was made by solvent casting method. A polymeric dispersion of *Sapindus mukorossi* was prepared by dissolving in optimum amount of water, respectively and prepares different batches from F1-F7 and optimizes batch on the bases of drug entrapment efficiency (Table 1) and then F6 Optimized formulation taken for preparing other formulations. In previous polymeric dispersion of optimize batch, amount of stearic acid was increased in batch F6S5 (5mg) followed by F6S10 (10mg), F6S15 (15mg), F6S20 (20mg), and F6S25 (25), respectively, with addition of Famotidine by vigorous stirring as stated in Table 1. The resulting solution was casted on Teflon plates (4×2cm<sup>2</sup>) and was allowed to dry in a hot air oven for 4 hrs at 40°C. After drying, the films were carefully removed with the help of a sharp blade (Shakuntla *et al.*, 2014, Sivaneswari *et al.*, 2017; Rishikesh *et al.*, 2015).

**Table1: Optimization of Drug: polymer ratio**

Batch Code	Wt. of Famotidine (mg)	Wt. of <i>Sapindus mukorossi</i> (mg)	Surface pH (mean±SD)	Drug Entrapment Efficiency	Muco adhesive time (min)
F1	20	20	6.65±0.02	72±0.02	200
F2	20	40	6.56±0.06	81±0.72	270
F3	20	60	6.61±0.03	84.1±0.16	290
F4	20	80	6.69±0.01	89±0.42	320
F5	20	100	6.54±0.04	91±0.32	345
<b>F6</b>	<b>20</b>	<b>120</b>	<b>6.67±0.01</b>	<b>95±0.21</b>	<b>370</b>
F7	20	140	6.72±0.07	92±0.41	389



**Optimization of mucoadhesive Gastro retentive film**

In this study three factor namely, concentration of isolated bio material (20,40,60,80,100,120,140 in mg) Amount of stearic acid(0,5,10,15,20,25 in mg) were selected as independent variables while thickness, drug entrapment efficiency, Moisture absorbed (%) and In vitro drug release were the dependent variables used for optimization of process variables (independent variables) in preparation of mucoadhesive gastro retentive film.

**Characterization of polymeric films:****Drug Polymer Interaction Studies:**

Although excipients are considered to be pharmacologically inert, but excipients can initiate, propagate or participate in chemical or physical interactions with drug compounds, which may compromise the effectiveness of a medication. Excipients may also contain impurities or form degradation products that in turn cause decomposition of drug substances. Drug interaction study (Shakuntla *et al.*, 2014, Sivaneswari *et al.*, 2017) was performed by taking three different ratios of drug and biomaterial 1:1, 1:2, 1:3. The U.V. absorbance of the three ratios was taken and compared with the absorbance of pure drug.

**Dry method:** The drug and standard polymers and isolated biomaterials are to be mixed in various

ratios (1:1, 1:3, 3:1, 1:20) in watch glass at room temperature and the results are to be analyzed.

**SEM Analysis:**

SEM (268D, Fei-Philips Morgagni) of polymeric film from batch F6S0 and F6S25 was performed at an acceleration voltage of 15 KV at different magnifications.

**Evaluation of polymeric films:****Uniformity of weight of the patches:**

Patch size of 1 x 1 cm<sup>2</sup> was cut. The weight of each patch was taken and the weight variation was calculated.

**Thickness**

Digital micrometer screw gauge (Aerospace,China) was used to measure thickness of polymer film at different strategic locations which is essential to ascertain uniformity of the film thickness.

**Surface pH:**

Anagar plate was prepared by dissolving 2 % (w/v) agar in warmed HCl buffer of pH 1.2 with continuous stirring and then pouring the solution into a petridish till gelling at room temperature. Then the patches of films were left to swell for 2 hr on the surface of the agar plate. The surface pH was measured by means of a pH paper placed on the surface of the swollen patch. The mean of three reading was recorded (Rishikesh *et al.*, 2015).

**Table 2 Composition of drug loaded polymeric films containing different amount of stearic acid**

Batch Code	Wt. of Famotidine(mg)	Wt. of <i>Sapindus mukrossi</i> (mg)	Wt. of stearic acid (mg)	Amount of PEG 400 (ml)
F6S0	20	120	0	0.2
F6S5	20	120	5	0.2
F6S10	20	120	10	0.2
F6S15	20	120	15	0.2
F6S20	20	120	20	0.2
F6S25	20	120	25	0.2

**Optimization of mucoadhesive Gastro retentive film**

In this study three factor namely, concentration of isolated bio material (20,40,60,80,100,120,140 in mg) Amount of stearic acid(0,5,10,15,20,25 in mg) were selected as independent variables

while thickness, drug entrapment efficiency, Moisture absorbed (%) and In vitro drug release were the dependent variables used for optimization of process variables (independent variables) in preparation of mucoadhesive gastro retentive film.



### Drug Entrapment and Content Uniformity of Patches

The patches were tested for the content uniformity. A patch of size 1 x 1 cm<sup>2</sup> was cut and placed in a 100 ml volumetric flask containing 100ml pH 1.2 Acidic buffer solutions. The contents were kept for 24 hours to complete dissolve the patch. After making proper dilution to the stock solution if necessary, the absorbance of the solution was measured against the corresponding blank solution at 265 nm.

### Measurement of Mucoadhesive Time

The mucoadhesive performance of the Gastro retentive film was evaluated using goat stomach tissue. The time for patch to detach from the goat stomach tissue in a well-stirred beaker were used to assess the mucoadhesive performance. The fresh goat stomach tissue was fixed on the side of the beaker with glue. Before addition of the buffer, the patch was attached to goat stomach tissue by applying light force with fingertip for 20 second. The beaker was then filled with 800 ml Acidic Buffer and kept at 37°. A stirring rate of 50 rpm was used to simulate movement. The time for the patch to detach from the goat stomach tissue was recorded as the mucoadhesion time (Sharad et al., 2012).

### Folding endurance

Folding endurance was determined by repeatedly folding the film at the same place until it breaks. The number of times the film could be folded at the same place without breaking was taken as the folding endurance value. It is an indirect assessment of toughness of film where lower value of folding endurance indicates brittleness of the film (Sivaneswari et al., 2017; Rishikesh et al., 2015; Sharad et al., 2012).

### Tensile strength

Tensile strength is the maximum load that a strip specimen can support without fracture when being stretched, divided by the original cross-sectional area of the material. The weight was gradually increased so as to increase the pulley force till the film breaks. The percent elongation before the film breaks was noted with the help of a magnifying glass on

graph paper and tensile strength was calculated as kg/cm<sup>2</sup> (Rishikesh et al., 2015).

### Water vapour transmission

Polymeric films were fixed on the brim of the pre-weighed glass vials (5ml) containing fused calcium chloride (1g) with an adhesive, in a humidity chamber at different humidity.

### Percent moisture absorbed

The presence of moisture may not affect the hardness of the film in normal environmental conditions but may be affected in exaggerated conditions. Pre-weighed polymeric films were placed in humidity chamber maintained at 68% RH for 72 h (Vipul et al., 2013) The percent moisture absorbed was calculated using formula:

$$\% \text{ moisture absorbed} = \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \times 100$$

### In vitro drug release study

In vitro drug release study of various batches were conducted in simulated gastric fluid medium (900 ml) using USP apparatus I (Thermonik Campbell electronic-DR-08, India) with constant temperature maintained at 37 ± 0.5° C and 50 rpm till 13 h. An aliquot of 5 ml was withdrawn and replaced with another 5 ml of fresh simulated gastric fluid medium at various time intervals. The contents of famotidine in sample were analyzed by double beam UV spectrophotometer at max 265 nm. Then the corresponding concentrations were determined from the standard curve of famotidine prepared in simulated gastric fluid medium (pH 1.2) at max 265 nm (Peppaset al., 1985).

### Modeling and release kinetics

To explore the kinetic behavior, results of in vitro release of famotidine from polymeric film was fitted to zero order, first order, Higuchi square root equation and Koresmeyer–Peppas equation and the value of K was determined for different models (Higuchi et al., 1963; Banerjee, et al., 2013).

### Stability studies

Stability studies for polymeric films were carried out in triplicate for three months at 45 ± 2 °C and 75% RH. At the end of the period physical



parameters and release profiles were determined (Mohana *et al.*, 2013; Rishikesh *et al.*, 2014).

## Results and discussion

**Optimization of drug polymer ratio:** Table 1 shows that the DEE increased by increasing Polymer concentration from 20 mg to 120mg.

Increasing polymer concentration above 120mg did not show increased DEE as compare to formulation F6. Thus Polymer concentration was maintained at 120mg in all next formulation. Formulation F6 containing 120mg polymer and 20mg Famotidine shows best Drug Entrapment Efficiency was selected for further investigations.

**Table 3: Optimization of stearic acid (mg)**

Formulation code	Wt. of Famotidine (mg)	Wt. of <i>sapindus mukrossi</i> (mg)	Wt. of stearic acid (mg)	Thickness ( $\mu\text{m}$ )	Moisture absorbed (%)	Percentage drug release
F6S0	20	120	0	58 $\pm$ 0.01	12.92 $\pm$ 0.25	85.79%
F6S5	20	120	5	63 $\pm$ 0.02	8.97 $\pm$ 0.12	81.03%
F6S10	20	120	10	70.3 $\pm$ 0.05	6.86 $\pm$ 0.32	78.20%,
F6S15	20	120	15	73.2 $\pm$ 0.03	5.68 $\pm$ 0.26	70.68%,
F6S20	20	120	20	78.3 $\pm$ 0.06	6.59 $\pm$ 0.19	61.20%
F6S25	20	120	25	83.2 $\pm$ 0.04	5.91 $\pm$ 0.30	59.99%

### Optimization of stearic acid concentration

Table-3 shows that 6 different concentration of stearic acid 0mg, 5mg,10mg,15mg,20mg,25mg used for formulation of Gastro retentive film and results shows that as the amount of stearic acid increased that formulation F6S25 showed a minimum percentage drug release of 59.99 which indicates a fast release during the first hour followed by a more steady drug release during a 12-h period and F6S25 formulation also shows that minimum moisture absorption due to the presence of higher concentration of stearic acid.

### Characterization of polymeric films

#### Drug-Polymer Interaction Study

Drug polymer interaction study was performed by dry method by using UV spectrophotometric analysis. The UV spectrophotometric analysis showed that there was no significant interaction between the drug and the biopolymers in different ratios, as the  $\lambda_{\text{max}}$  values (264-266) are very close to the  $\lambda_{\text{max}}$  value of pure drug (265nm) as shown in Table 4. Hence no changes were found in the  $\lambda_{\text{max}}$  value of both the biopolymer as compared to pure drug this

**Table 4: Drug polymer Interaction study by UV spectrophotometric analysis.**

S.No	Different Ratios	$\lambda_{\text{max}}$ . after 1 hr	$\lambda_{\text{max}}$ . after 2 hr	$\lambda_{\text{max}}$ . after 3 hr	$\lambda_{\text{max}}$ .of Pure Drug
1	1:1	265	265	265	265
2	1:3	266	266	264	265
3	3:1	264	264	265	265
4	1:20	265	265	266	265

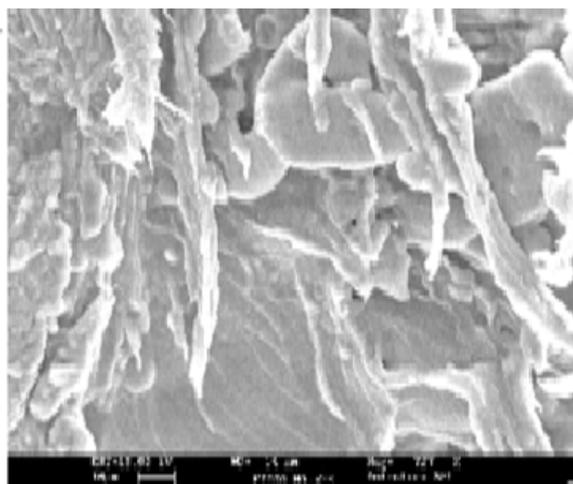


shows that both the biopolymer and drug was safe in nature so they can be used for further studies i.e. for formulating films as they are obtained from natural sources.

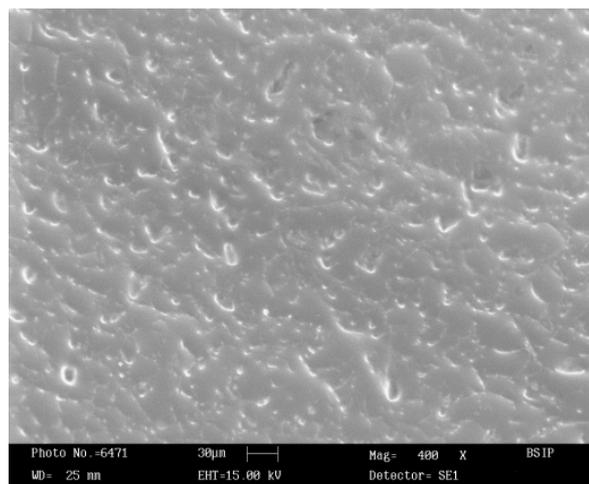
### SEM analysis

The surface morphology of polymeric films was shown in Fig.1 Batch F6S0 at 727x showed fibrous structure (Fig.1a). The surface

morphology of polymer film of batch F6S25 at the magnification of 398x shows particulate material scattered on the surface with polyhedral depressions which is due to the stearic acid surrounded by the drug, form a channel for leaching out of the drug and which may be responsible for the maximum drug release at first hour (Fig.1b).



(a)



(b)

**Fig.1. Scanning electron micrograph of (a) polymeric film of batch F6S0; (b) polymeric film of batch F6S25**

### Evaluation of formulated polymeric films:

#### Thickness

The thickness of prepared film varied from 58–83.2µm. Maximum thickness was observed with F6S25 batch whereas the minimum thickness was of F6S0 batch which may be due increase in concentration of stearic acid in F6S0, F6S5, F6S10, F6S15, F6S20, F6S25, respectively, as shown in Table 3.

#### Weight uniformity

Weight uniformity for formulation F6S0 to F6S25 varied from 48.5±0.11mg to 60.8±0.10mg (table 5). The patches were found uniform.

#### Surface pH

An acidic or alkaline formulation is bound to cause irritation on the GIT membrane. Surface pH of formulation F6S0 to F6S25 varied from 6.54 ± 0.04 to 6.69±0.01 (table 5). Each sample is analyzed in triplicate (n=3). The surface pH of all formulations was within ± 0.15 units of the neutral

pH and hence no mucosal irritation was expected and ultimately achieves patient compliance.

#### Drug Content Uniformity and Drug Entrapment

Drug entrapment of formulation F6S0 to F6S25 varied from 95.66% to 98.21% (as shown in table 5) and formulation F1 to F7 varied from 72±0.02to 95±0.21% ( table 2). Drug content uniformity formulation F6S0 to F6S25 varied from 19.23±0.17to 19.88±0.15 (as shown in table 5) which was within the desirable range.

#### Mucoadhesion Time

Mucoadhesion Time of formulations F1 to F7 varied from 200minut-389minut (as shown in table 2). The results showed that polymer with higher concentration provide a better Mucoadhesion Time for the polymeric film.

#### Folding endurance of polymer films

Folding endurance was determined by repeatedly folding the film at the same place until it breaks. The number of times the film could be folded at the same place without breaking was the folding endurance value.

**Table 5 Physical characteristics of polymeric films**

Formulation code	Weight uniformity (mg) (mean±SD)	Surface pH (mean±SD)	Content Uniformity (mean±SD)	% Entrapment
F6S0	48.5±0.11	6.65±0.02	19.23	95.66
F6S5	50.6±0.12	6.56±0.06	19.65	96.01
F6S10	51.1±0.21	6.61±0.03	19.27	97.32
F6S15	53.2±0.17	6.69±0.01	19.49	97.49
F6S20	58.5±0.21	6.54±0.04	19.32	97.98
F6S25	60.8±0.10	6.67±0.01	19.88	98.21

The minimum folding endurance was of F6S0 batch and that was increased due to increase in PEG 400 concentration up to 0.7 ml. After that polymer film could not dry and it was difficult to peel off from the plate. It was observed that PEG 400 was necessary for the success of dosage form which shall otherwise be brittle.

#### Tensile strength

There was not much difference in tensile strength of various batches but it was increased as the concentration of PEG 400 was increased, because of the presence of PEG 400 which may be acting as plasticizer. The results showed that PEG with higher concentration provides a better plasticizing effect for the polymeric film but increases the water vapour permeability of the

film. Batch F6S25 was found to have maximum (up to 320 g) tensile strength as described in Table 6.

#### Water vapour transmission

Water vapour transmission test was done at four different humidities (30%, 75%, 80%, 90%). As the humidity was increased, the weight gain by fused CaCl<sub>2</sub> also increased. The maximum weight gain was at 90% relative humidity. Batch F6S25 showed minimum weight gain by fused CaCl<sub>2</sub>. Based on the observation, it may be concluded that the membrane possessed negligible permeability indicating the success of method of formulation (casting) to yield film of sufficient thickness without pores/thin areas. It may be due to the presence of more stearic acid, a hydrophilic polymer which may act as a moisture barrier from outside as depicted in Table 7.

**Table 6: Tensile strength of polymeric films**

Weight suspended (g)	Increase in length (cm)					
	F6S0+ PEG 400 (0.2 ml)	F6S5+ PEG 400 (0.3 ml)	F6S10+ PEG 400 (0.4 ml)	F6S15+ PEG 400 (0.5 ml)	F6S20+ PEG 400 (0.6 ml)	F6S25+PEG 400(0.7 ml)
30	7.2 ± 0.12	7.3 ± 0.09	7.1 ± 0.23	7.2 ± 0.11	7.0 ± 0.2	<b>7.1 ± 0.09</b>
60	7.8 ± 0.32	7.4 ± 0.10	7.2 ± 0.22	7.5 ± 0.32	7.3 ± 0.11	<b>7.2 ± 0.19</b>
90	8.3 ± 0.36	7.4 ± 0.33	7.5 ± 0.17	7.6 ± 0.21	7.4 ± 0.21	<b>7.3 ± 0.09</b>
120	8.8 ± 0.43	7.5 ± 0.36	7.7 ± 0.18	8.0 ± 0.43	7.5 ± 0.31	<b>7.7 ± 0.18</b>
150	9.4 ± 0.54	7.6 ± 0.28	7.7 ± 0.33	8.4 ± 0.26	7.8 ± 0.27	<b>7.9 ± 0.29</b>
180	9.7 ± 0.33	7.7 ± 0.19	7.8 ± 0.14	8.9 ± 0.16	8.4 ± 0.12	<b>8.3 ± 0.20</b>
210	Break	8.0 ± 0.38	7.9 ± 0.33	9.4 ± 0.12	8.6 ± 0.16	<b>8.5 ± 0.28</b>
240	Break	8.1 ± 0.19	8.1 ± 0.28	9.5 ± 0.10	9 ± 0.15	<b>9.6 ± 0.19</b>
270	Break	8.2 ± 0.20	8.2 ± 0.10	9.6 ± 0.12	9.5 ± 0.22	<b>9.8 ± 0.22</b>
300	Break	Break	Break	Break	9.9 ± 0.16	<b>10.0 ± 0.09</b>
320	Break	Break	Break	Break	Break	<b>10.9 ± 0.23</b>



**Table 7: Water vapour transmission of polymeric films**

Relative humidity	Weight gained (mg) by batch					
	F6S0	Gastro retentive film of Famotidine using Bio-Material			F6S20	F6S25
30%	0.58 ± 0.09	0.55 ± 0.18	0.51 ± 0.10	0.46 ± 0.19	0.44 ± 0.15	0.41 ± 0.12
75%	0.69 ± 0.13	0.70 ± 0.14	0.68 ± 0.10	0.67 ± 0.31	0.69 ± 0.08	0.66 ± 0.21
80%	0.77 ± 0.24	0.75 ± 0.22	0.72 ± 0.26	0.72 ± 0.13	0.70 ± 0.20	0.69 ± 0.16
90%	0.89 ± 0.18	0.86 ± 0.25	0.85 ± 0.11	0.84 ± 0.14	0.82 ± 0.35	0.80 ± 0.19

**Percent moisture absorbed**

The maximum moisture was absorbed by F6S0 formulation and the least by F6S25 formulation. This may be due to the presence of stearic acid in F6S25 formulation which may act as a moisture barrier (Table 3).

**In vitro dissolution studies**

The in vitro drug release study from all six set of formulation (F6S0, F6S5, F6S10, F6S15, F6S20 and F6S25) was performed. The result revealed that formulation F6S25 showed a minimum percentage drug release of 59.98% followed by the formulation F6S20, F6S15, F6S10, F6S5 and F6S0 of 61.20%, 70.68%, 78.20%, 81.03% and 85.79% in 13h, respectively, which indicates a fast release during the first hour followed by a more steady drug release during a 12-h period as the concentration of stearic acid was increased. Stearic acid, a hydrophobic polymer, used as sustained drug delivery, reduces the drug release from the formulation, as it surrounds the drug and *Sapinduss mukrossi* and make channels from which the drug leaches out more initially and later release slowly by diffusion from *Sapinduss mukrossi*. During the hydration of *Sapinduss mukrossi*, there is formation of gel layer around the dry core of *Sapinduss mukrossi* and swelling of polymer takes place which attributes to be used as an oral controlled drug delivery system because of its high swellability (Fig. 2a).

**Drug release kinetics**

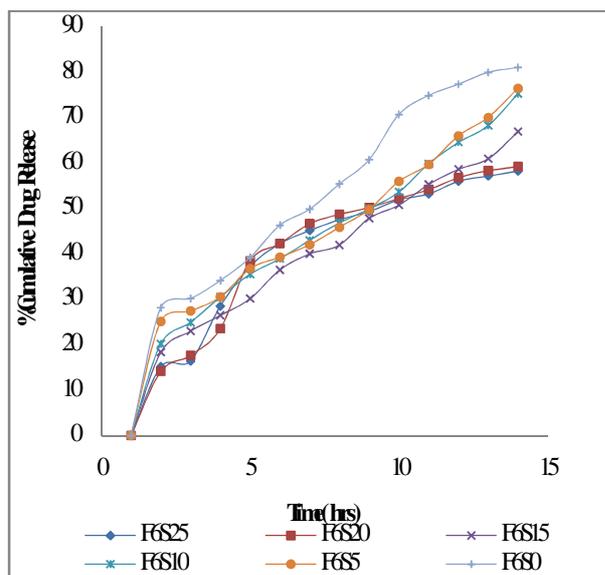
The data obtained from dissolution studies of different batches was analyzed using different mathematical models for the determination of release kinetics. Most of the batches exhibited the

maximum regression coefficient values for Zero order model, thus representing absolute correlation between the two variables of various batches for the Zero order model proving that the release was by diffusion and erosion mechanism. However, the release mechanism is not well known or more than one type of release phenomenon be involved. The highest value of R<sup>2</sup> for various batches are as follows: 0.938 (higuchi), 0.9343 (higuchi), 0.9914 (Zero order), 0.9962 (Zero order), 0.9955 (crossmeyer model) and 0.9863 (Zero order) for F6S25, F6S20, F6S15, F6S10, F6S5, and F6S0 batches, respectively. The Korsmeyer and Peppas equation was used for Determining values of release exponent (n) and the 'n' value of all batches determined to be ≤ 0.5 indicating Quasi-fickian diffusion. The data indicates that with an increase in concentration of stearic acid, erosion of film was decreased. The result revealed that polymeric film of batch F6S25 had minimum erosion as compared to other batches.

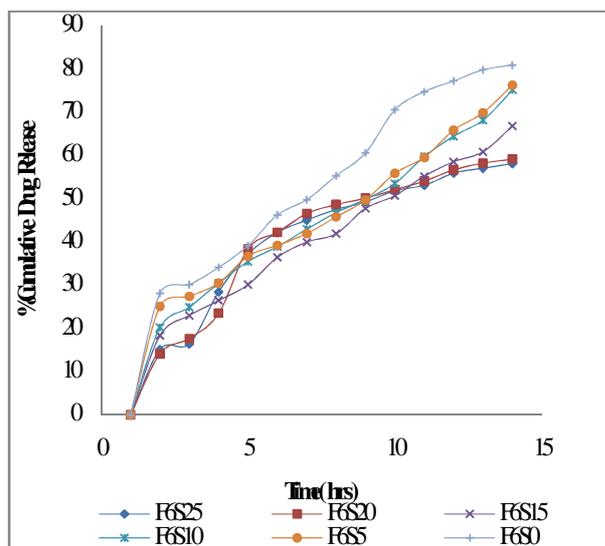
**Stability studies**

The results of stability studies of famotidine loaded polymeric films shows more sustained effect as compared to previous drug release studies. When the polymeric films were stored at 45 ± 2°C and 75% RH for 3 months, it was observed that polymers and stearic acid mixture formed a transparent hard film like insoluble substance which may be due to their mutual interaction that may have reduced the porosity of the polymeric film. This will reduce the opening of the dissolution medium leading to slower dissolution (Fig. 2b). But there was a slight change in mechanical properties of the polymer film.





a)



b)

**Fig.2. Comparative in vitro release profile of Famotidine from various batches of polymeric films. (a) Before stability testing; (b) after stability testing.**

### Conclusion

The gastro retentive film for controlled release of famotidine a drug with narrow absorption window was successfully formulated. The formulated batches were characterized through various physicochemical parameters like, release characteristics, floating cum mucoadhesive characteristics, stability study and integrity during

their release period. The observed response is close agreement with the predicted parameters there by demonstrating the feasibility of the procedure. The presence of stearic acid in polymeric film was crucial to provide an immediate and sustained effect. In conclusion, novel gastroretentive mucoadhesive films indicated the gastroretentive potential of the dosage form for drug having absorption from stomach and had higher bioavailability in stomach. We can certainly explore this drug delivery system for further development through its in vivo evaluation studies which may lead to an improved bioavailability and ensured therapy with other already existing drugs of such type.

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