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# Formulation and Evaluation of Colon Specific Drug Delivery of Press Coated Esomeprazole Tablets

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**ABSTRACT**

*The basic aim of the present investigation is to formulate and evaluate colon specific press coated tablets of esomeprazole .esomeprazole tablets were successfully prepared using enteric coated polymers ethyl cellulose and HPMC pthallate by first preparing the core tablets and then press coated with polymers. study of the preformulation characteristics and FTIR studies indicates that there was no interaction between esomeprazole and excipients used in the formulation. Invitro release profiles of optimized form of F6 were found to showed delayed release pattern in a very customized manner which was very much required for the colon specific drug delivery. . In vitro release profiles of optimized formulation of esomeprazole controlled release tablets (F-6) were found to be improvised and followed zero - order kinetics, hence the release of the drug from the dosage form was independent of concentration and followed Higuchi model, and hence release of drug from press coated tablet was by diffusion mechanism. The drug delivery system was designed to deliver the drug at such a time when it was needed nocturnal time.*

**Keywords**: esomeprazole, Zollinger-Ellison syndrome, FTIR, dissolution profile

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## INTRODUCTION

Colon is being extensively investigated as a drug delivery site. Oral colon-specific drug delivery system (CDDS) has been developed by means of combination of one or more controlled release mechanisms, hardly releases drug in the upper part of the gastrointestinal (GI) tract, but rapidly releases drug in the colon following oral administration CDDS is convenient for treating localized colonic diseases, i.e. ulcerative colitis, Crohn's disease and constipation *etc.*, CDDS, also selectively deliver drug to the colon, but not to the upper GI tract. Colon is referred to as the optimal absorption site for protein and polypeptide after oral administration, because of the existence of relatively low proteolytic enzyme activities and quite long transit time in the colon [1.2]. CDDS would be advantageous when a delay in absorption is desirable from a therapeutically point of view, as for the treatment of diseases that have peak symptoms in the early morning and that exhibit circadian rhythms, such as nocturnal asthma, angina and rheumatoid arthritis. A large number of polysaccharides such as pectin, amylose, guar gum, chitosan, inulin, cyclodextrins, chondroitin sulphate, dextrans, dextrin and locust bean gum have been investigated for their use in colon targeted drug delivery systems.[3] Esomeprazole belongs to a group of drugs called proton pump inhibitors. It decreases the amount of acid produced in the stomach. Esomeprazole is used to treat and prevent stomach and intestinal ulcers, erosiveesophagitis (damage to the esophagus from stomach acid), and other conditions involving excessive stomach acid such as Zollinger-Ellison syndrome [4]. In Peptic ulcer patients, gastric distress occurs is most likely in the late night and early morning hours. Ulcerative pain frequently occurs after stomach emptying, following daytime meals and in the very early morning, disrupting sleep. This is attributed to high gastric secretion and slows gastric motility and emptying at night. Suppression of nocturnal gastric acid secretion is an important factor in duodenal ulcer healing. Once daily nocturnal administration of proton pumps inhibitor medications not only reduce acid secretion more effectively but also promote ulcer healing and reduce ulcer

occurrence. The rational of this study is to design and evaluate an oral site-specific colon drug delivery system containing Esomeprazole, which can be targeted to colon in a pH and time dependent manner.

## MATERIALS AND METHODS

Esomeprazole was obtained as a gift sample from hetero labs and ethylcellulose, microcrystallinecellulose, crosspovidone, crosscaramellose sodium,sodium starch glycollate, magnesium sterate, hydroxy propyl methyl cellulose were obtained from merck specialities pvt ltd, Mumbai, india used in the formulation of tablets.

Methodology

**Formulation of core tablets by direct compression:**

The inner core tablets were prepared by using direct compression method. As shown in Table 1 powder mixtures of Esomeprazole, microcrystalline cellulose (MCC, Avicel PH-102), cross-carmellose sodium (Ac-Di-Sol), SSG, crospovidone, ingredients were dry blended for 20 min. Followed by addition of Magnesium Stearate. The mixtures were then further blended for 10 min., 150mg of resultant powder blend was manually compressed using KBr hydraulic press at a pressure of 1 ton, with a 8mm round punch and die to obtain the core tablet.

**Formulation of mixed blend for barrier layer:**

The various formulations containing Ethylcellulose and HPMC in different compositions were weighed dry blended at about 10 min and used as press-coating material to prepare press-coated tablets respectively by direct compression method.

**Preparation of press-coated tablets:**

The core tablets were press-coated with 400mg of mixed blend/granules as given in Table 3. 200mg of barrier layer material was weighed and transferred into a 12mm die then the core tablet was placed manually at the center. The remaining 200mg of the barrier layer materiel was added into the die and compressed at a pressure of 5 tons for 3min using KBr hydraulic press.

**Preparation of enteric coating solution**:

Polymer solution was prepared with HPMC phthalate, myvacet and colour in ethanol as solvent.

## FORMULATION OF ESOMEPRAZOLE TABLETS (COLON TARGETING DRUG DELIVERY)

**Table no 1 Formulation for core tablet:**

| S. No. | Ingredients | F 1 | F 2 | F 3 | F 4 | F 5 | F 6 | F7 | F8 | F9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Esomeprazole | 20 mg | 20 mg | 20 mg | 20 mg | 20 mg | 20 mg | 20 mg | 20 mg | 20 mg |
| 2. | Micro crystalline cellulose | q.s | q.s | q.s | q.s | q.s | q.s | q.s | q.s | q.s |
| 3. | Cross povidone | 3.6 mg | 5.4 mg | 9.0 mg | | | | | | |
| 4. | Cross caramellose sodium | | | | 3.6 mg | 5.4 mg | 9.0 mg | | | |
| 5. | Sodium starch glycolate | | | | | | | 3.6 mg | 5.4 mg | 9.0 mg |
| 6. | Magnesium stearate | 2mg | 2 mg | 2 mg | 2 mg | 2 mg | 2 mg | 2 mg | 2 mg | 2 mg |
| | **Total wt** | 150mg | 150mg | 150mg | 150mg | 150mg | 150mg | 150mg | 150mg | 150mg |

**Formulation for press coat: table no 2**

| **Press coat** | P1F6 | P2F6 | P3F6 | P4F6 | P5F6 |
|---|---|---|---|---|---|
| HPMC | 400 | 100 | 300 | 200 | 0 |
| E.C | 0 | 300 | 100 | 200 | 400 |
| **Total wt** | 400mg | 400mg | 400mg | 400mg | 400mg |
| **Eneteric coated formula** | | | | | |
| **HPMC phthalate 55** | 17.17mg | | | | |
| Myvacet | 1.72mg | | | | |
| Ferric oxide (red) | 2.58mg | | | | |
| Ethanol | q.s | | | | |

## PREFORMULATION STUDIES

Preformulation studies are performed to investigate the physical and chemical properties of a drug substance alone and also when combined with other substances such as excipients. It is the first step in the rational development of dosage forms. The use of preformulation parameters maximizes the chances in formulating an acceptable, safe, efficacious and stable product and at same time provides the basis for optimization of the drug product quality.

**PREPARATION OF STANDARD CALIBRATION CURVE OF ESOMEPRAZOLE IN 0.1N HCL**

***Preparation of standard solution:***

Standard stock solution of Esomeprazole was prepared in 0.1N HCL. 100 mg of Esomeprazole was accurately weighed into 100ml volumetric flask and dissolved in small quantity of buffer. The volume was made up with water to get a concentration of 1000µg/ml (SS-I).

From this 10 ml solution was withdrawn and diluted to 100ml of 0.1N HCL to get a concentration of 100µg/ml (SS-II).

***Preparation of working standard solutions:***

Further, from (SS-II) aliquots of 0.3ml, 0.6ml, 0.9ml, 1.2ml, 1.5ml and 1.8ml were pipetted into 10ml volumetric flasks. The volume was made up with 0.1N HCL to get the final concentrations of 3,6,9,12,15 and 18µg/ml respectively. The absorbance of each concentration was measured at 285nm.The data are compiled in Table and plotted a graph.

*λ Max :*285nm.

*Beer's range:* 3-18 µg /ml.

**PREPARATION OF STANDARD CALIBRATION CURVE OF ESOMEPRAZOLE IN pH6.8 PHOSPHATE BUFFER**

***Preparation of standard solution:***

Standard stock solution of Esomeprazole was prepared in Phosphate buffer pH6.8. 100 mg of Esomeprazole was accurately weighed into 100ml volumetric flask and dissolved in small quantity of buffer. The volume was made up with water to get a concentration of 1000µg/ml (SS-I).

From this 10 ml solution was withdrawn and diluted to 100ml of phosphate buffer pH6**.8** to get a concentration of 100µg/ml (SS-II).

***Preparation of working standard solutions:***

Further, from (SS-II) aliquots of 0.3ml, 0.6ml, 0.9ml, 1.2ml, 1.5ml and 1.8ml were pipetted into 10ml volumetric flasks. The volume was made up with phosphate buffer pH6**.8** to get the final concentrations of 3,6,9,12,15 and 18µg/ml respectively. The absorbance of each concentration was measured at 285nm.The data are compiled in Table and plotted a graph.

*λ Max :*285nm.
*Beer's range:* 3-18 µg /ml.

**Flow Properties:**

**Angle of Repose:**

The flow property was determined by measuring the Angle of Repose. In order to determine the flow property, the Angle of Repose was determined. It is the maximum angle that can be obtained between the free standing surface of a powder heap and the horizontal.

Angle of repose= $\tan^{-1}$ (h/r)

Where,
h = height of a pile (2 cm)
r = radius of pile base.

**Bulk density:**

Bulk density is ratio of given mass of powder and its bulk volume. Bulk density was determined by measuring the volume of known mass of powder sample that has been passed through the screen in to graduated cylinder or through volume measuring apparatus in to cup.

Bulk density = $M / V_0$
Where M= mass of the powder;
$V_0$=bulk volume of the powder.

Limits:
It has been stated that the bulk density values having less than 1.2 g/cm3 indicates good packing and values greater than 1.5 g/cm3 indicates poor packing.

**Tapped density:**
A known quantity of powder was transferred to a graduated cylinder and volume $V_0$ was noted. The cylinder fixed to a density determination apparatus, tapped for 500 times then reading was Observed. The density is achieved by mechanically tapped by a measuring cylinder containing the powder sample. After observing the initial volume the cylinder is mechanically tapped and volume reading were taken until little further volume changes is observed.
Tap density = M / Vr

Where M = mass of the powder,
Vr = final tapping volume of the powder.

**Compressibility index and Hausner ratio:**
The compressibility index and hausner ratio may be calculated using measured values of bulk density and tapped density as follows:

Compressibility index = 100 × tapped density / bulk density
Hausner ratio = tapped density / bulk density

Flow properties and corresponding Angle of repose, Compressibility index and Hausner ratio:

**TABLE NO. 3: Acceptance criteria of flow properties**

| S. No | Flow properties | Angle of repose(θ) | Compressibility Index (%) | Hausner ratio |
|---|---|---|---|---|
| 1. | Excellent | 25-30 | <10 | 1.00-1.11 |
| 2. | Good | 31-35 | 11-15 | 1.12-1.18 |
| 3. | Fair | 36-40 | 16-20 | 1.19-1.25 |
| 4. | Passable | 41-45 | 21-25 | 1.26-1.34 |
| 5. | Poor | 46-55 | 26-31 | 1.35-1.45 |
| 6. | Very poor | 56-65 | 32-37 | 1.46-1.59 |
| 7. | Very very poor | > 66 | >38 | >1.6 |

**Angle of repose:**
The friction forces in a loose powder can be measured by the angle of repose (q). It is an indicative of the flow properties of the powder. It is defined as maximum angle possible between the surface of the pile of powder and the horizontal plane

Tan **θ=h/r**

Where h and r are the height of pile and radius of the base of pile.

Different ranges of flowability in terms of angle of repose are given below in the table no.4

**Table no 4 Relationship between Angle of Repose (θ) and flow properties**

| Angle of Repose (θ) (degrees) | Flow |
|---|---|
| <25 | Excellent |
| 25-30 | Good |
| 30-40 | Passable |
| >40 | Very poor |

**Drug – Excipient Compatibility Study [6]:**
Drug is in intimate contact with one or more excipient in all the dosage forms. Later it could affect the stability of drug. Knowledge of drug excipient interaction is useful in selecting an appropriate excipient.

Procedure:
API and excipient are taken in the ratios above mentioned and mixed together in a polybag for 5 min. Each mixture is allotted sample code for identification. 4 sets of sample were allocated where each sample mixture is divided in to 1g in to its corresponding glass vial (USP Type I) at different conditions.

All vials are properly sealed and loaded at respective conditions. The samples are to be checked for its Description, Related substance and water content by KF.

RELEASE KINETICS[11]:
Mathematical models are used to evaluate the kinetics and mechanism of drug release from the tablets. The model that best fits the release data is selected based on the correlation coefficient (R) value in various models. The model with high 'R' value is considered as the best fit on the release data.

Zero order release:
The equation for zero order release is represented as

$Q_t = Q_o + K_o t$

Where, $Q_t$ = amount of drug released in time (t)
$Q_O$ = initial amount of drug in solution
$K_O$ = zero order release constant

First order release:
The equation for the first order release is represented as

$\text{Log } C = \text{Log } C_0 - Kt / 2.303$

where, C = amount of drug remaining unreleased at time (t)
$C_O$ = initial amount of drug in solution
K = first order rate constant

**Higuchi's model:**
The simplified Higuchi equation is represented as
$Q_t = Kt^{½}$

where, $Q_t$ = amount of drug released in time (t)
K = Higuchi' constant

A linear relationship between amount of drug released (Q) versus square root of time ($t^{1/2}$) is observed if the drug release from the matrix is diffusion controlled.

**Hixson-Crowell model:**
The simplified Hixson-Crowell equation is represented as

$Q_o^{1/3} - Q_t^{1/3} = Kt$
where, $Q_t$ = amount of drug released in time (t)
$Q_O$ = initial amount of drug in solution
K = cube root constant

A graphic representation of cubic root of unreleased fraction of drug versus time will be linear if geometric shape of the formulation diminishes proportionally over time.

**Korsmeyer- Peppas model:**
The Korsmeyer-Peppas model relates drug release exponentially to time. It is represented as

$M_t / M_{inf} = Kt^n$
where, $M_t / M_{inf}$ = fractional release of drug

K = constant depending on structural and geometric characteristics of the drug dosage form
n = release exponent

The value of n indicates the drug release mechanism. For a slab the value n = 0.5 indicates Fickian diffusion and values of n between 0.5 and 1.0 indicate non-Fickian mechanism. In case of a cylinder n = 0.45 instead of 0.5, and

0.89 instead of 1.0. This model is used to analyze the release of drug from polymeric dosage forms, when the release mechanism is not understood or when there is a possibility of more than one type of release mechanisms are involved.

**EVALUATION OF TABLETS:**
The quantitative evaluation and assessment of a tablets chemical, physical and bioavailability properties are important in the design of tablets and to monitor product quality. There are various standards that have been set in the various pharmacopoeias regarding the quality of pharmaceutical tablets. These include the diameter, size, shape, thickness, weight, hardness, disintegration and dissolution characters

**1. Weight variation:**
20 tablets were selected randomly from the batch and weighted individually to check for weight variation. Weight variation specification as per I.P. is shown in table No. 4

**Table 4 Weight Variation Specification as per IP**

| Average Weight of Tablets | %Deviation |
|---|---|
| 80 mg or less | ±10 |
| More than 80 mg but less than 250 mg | ±7.5 |
| 250 mg or more | ±5 |

**Hardness:**
Hardness is the force required to break a tablet in a diametric compression was measured using Monsanto tablet hardness tester and also Pfizer ,strong cobb and erwika testers. It is expressed in $kg/cm^2$.

**Thickness:**
Three tablets were selected randomly from each batch and thickness was measured by using Vernier Caliper.

**Friability (F):**
Friability of the tablet determined using Roche friabilator. This device subjects the tablet to the combined effect of abrasion and shock in a plastic chamber revolving at 25 rpm and dropping a tablet at the height of 6 inches in each revolution. Pre weighed sample of tablets was placed in the friabilator and were subjected to the 100 revolutions. Tablets were dusted using a soft muslin cloth and reweighed. The friability (F) is given by the formula.

$$F = \frac{W_{initial} - W_{final}}{W_{initial}} \times 100$$

**Disintegration test:**
First step in the approach of drug absorption process disintegration is the important step where the drug

Disintegration time: Uncoated tablet: 5-30 minutes.

Coated tablet: 1-2 hours

***In-vitro* release studies** [7,8]
Tablet was introduced into the basket of the LABINDIA TS 8000 USP dissolution test apparatus and the apparatus was set in motion at 50 rpm for time period of 1 hr, 5 ml of sample was withdrawn for every 5min intervals and replaced by pH6.8 phosphate buffer solutions. Samples withdrawn were analyzed by UV spectrophotometer for presence of drug using buffer solution as blank.

**Dissolution parameters:**

| | | |
|---|---|---|
| Apparatus | -- | USP-II, Paddle Method |
| Dissolution Medium | -- | pH6.**8** Phosphate buffer |
| RPM | -- | 50 |
| Sampling intervals (min) | -- | 5, 10, 15, 20, 30, 45, 60min. |
| Temperature | -- | 37 + 0.5°C |

***In-vitro* Dissolution methods for Enteric press-coated tablets**[8,9,11] **:**
In –vitro Dissolution studies of colon targeted drug delivery systems was done with the conventional paddle method of press coated tablets were performed at 37 ± 0.5 °C using 0.1N HCL in USP II paddle method at 50 rpm for first two hours and replaced with pH6.**8** phosphate buffer. 5 ml of filtered aliquot was manually withdrawn at pre-determined time intervals and replaced with 5 ml of fresh buffer solution maintained at the same temperature. The

samples were analysed at 285nm using a UV spectrophotometer. The lag time and percentage release was determined of the each formulation.

**Dissolution parameters for enteric press coated tablets:**

| | | |
|---|---|---|
| Apparatus | -- | USP-II, Paddle Method |
| Dissolution Medium | -- | first 2 hours 0.1 N HCl<br>Next 6.8pH Phosphate buffer |
| RPM | -- | 50 |
| Sampling intervals (hrs) | -- | 1, 2, 3, 4, 5, 6, 7 and 8 |
| Temperature | -- | 37 + 0.5°C |

**Table No 6 concentration and absorbance's of Esomeprazole in 0.1N HCL**

| S.No | Concentration | Absorbance |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 3 | 0.0729 |
| 3 | 6 | 0.1559 |
| 4 | 9 | 0.2339 |
| 5 | 12 | 0.3118 |
| 6 | 15 | 0.3798 |
| 7 | 18 | 0.4682 |

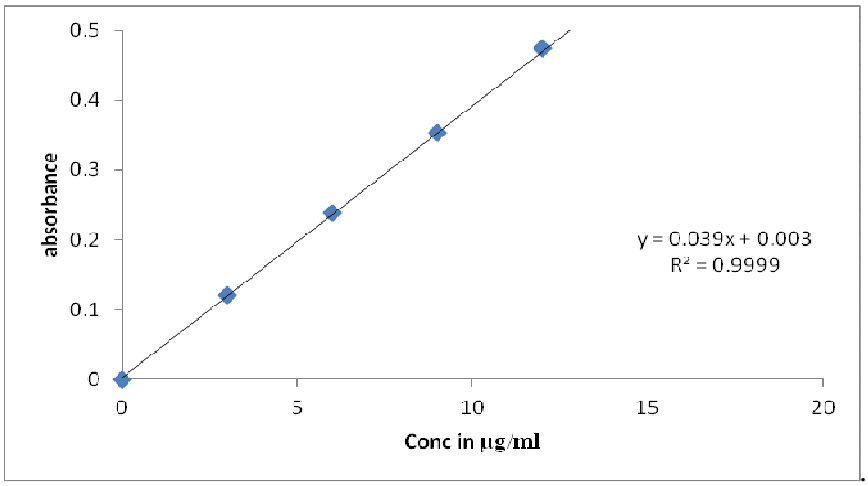


**FIG NO 1- calibration curve of Esomeprazole**

**Table No 7 concentration and absorbances of Esomeprazole in 6.8 pH Phosphate buffer**

| S.No | Concentration | Absorbance |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 3 | 0.121 |
| 3 | 6 | 0.238 |
| 4 | 9 | 0.354 |
| 5 | 12 | 0.475 |
| 6 | 15 | 0.586 |
| 7 | 18 | 0.702 |

**DRUG EXCIPIENT COMPATIBILITY STUDIES**

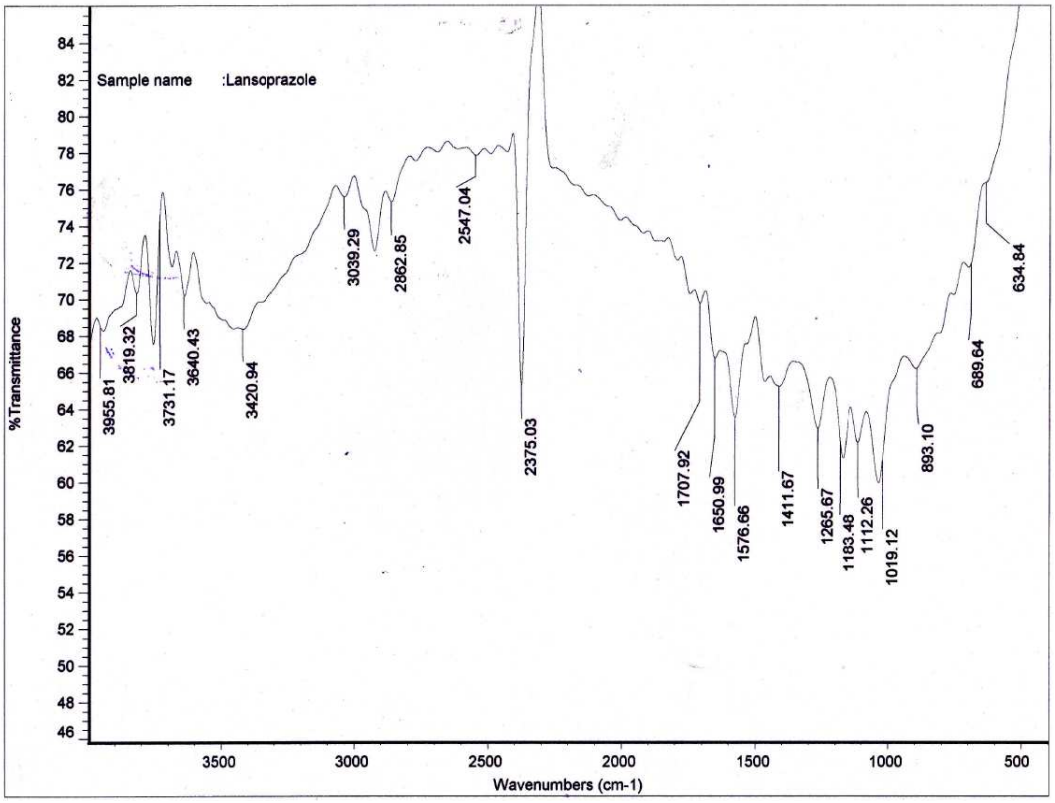


**Fig No 2: FTIR Spectra of Esomeprazole**

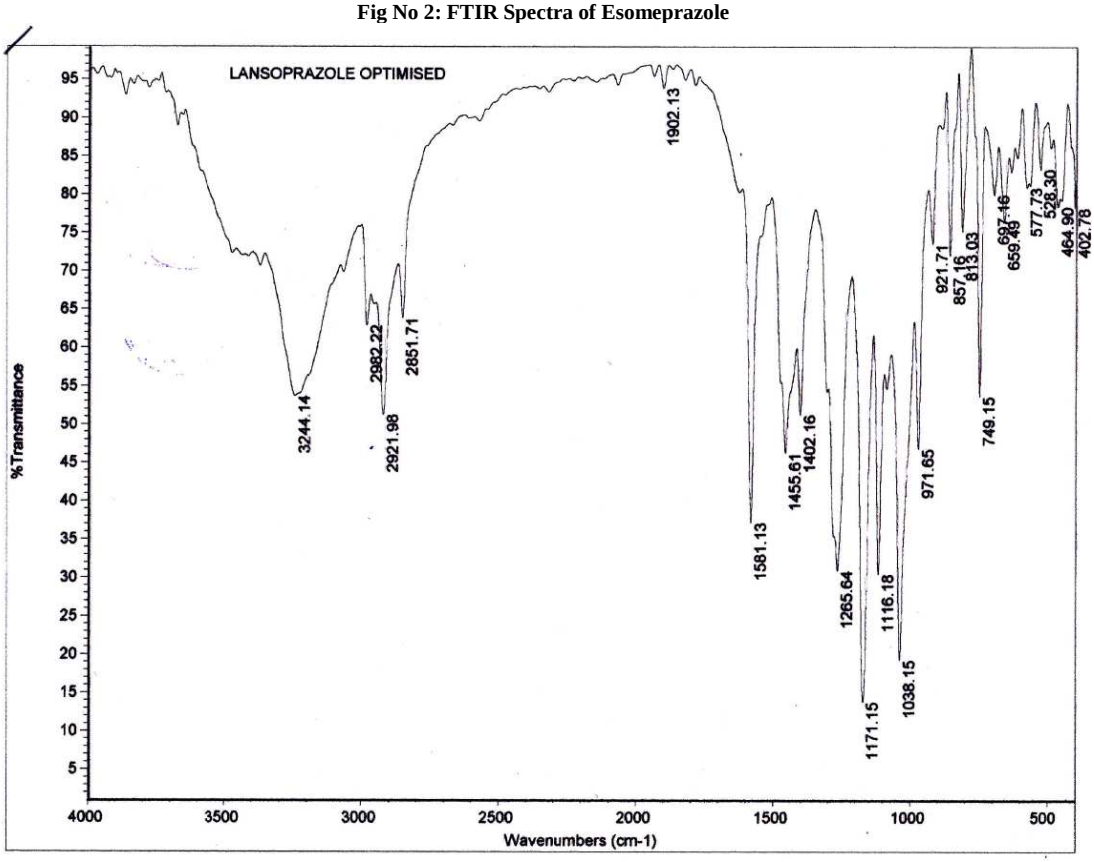


**Fig No 3: FTIR Spectra of Esomeprazole optimized formulation**

## PRE COMPRESSION PARAMETERS

**Table No 8 precompression parameters**

| Formulations | Angle of Repose (θ) | Loose Bulk Density (g/ml) | Tapped Bulk Density (g/ml) | % Compressibility | Hausner's ratio |
|---|---|---|---|---|---|
| **F1** | $21^0$ 55' | 0.510 | 0.583 | 12.52 | 1.14 |
| **F2** | $22^0$ 43' | 0.416 | 0.482 | 13.69 | 1.15 |
| **F3** | $25^0$ 02' | 0.423 | 0.495 | 14.54 | 1.17 |
| **F4** | $24^0$ 18' | 0.309 | 0.353 | 12.46 | 1.14 |
| **F5** | $26^0$ 89' | 0.306 | 0.355 | 13.80 | 1.16 |
| **F6** | $22^0$ 57' | 0.322 | 0.376 | 14.36 | 1.16 |
| **F7** | $25^0$ 98' | 0.404 | 0.472 | 14.40 | 1.16 |
| **F8** | $26^0$ 42' | 0.511 | 0.576 | 11.28 | 1.12 |
| **F9** | $24^0$ 62' | 0.506 | 0.577 | 12.30 | 1.14 |
| **F10** | $27^0$ 08' | 0.422 | 0.493 | 14.37 | 1.16 |

**From** the above pre-compression parameters it was clear evidence that drug and excipients has good flow properties and suitable for direct compression.

## POST COMPRESSION PARAMETERS

**Tooling:**

8mm round shape for core tablet

12mm round shape tooling for press coat.

**Evaluation of rapid release core (RRCT) and press-coated tablets of esomeprazole**

**Tablet compression parameters:**

Weight of the tablet 200 mg(core tablet)
600mg (press coated tablet)

Hardness range 5.5Kg/$cm^2$ (core tablet)
7.0 Kg/$cm^2$ (press coat tablet)

Thickness range 2.5 ± 0.3 mm(core tablet)
3.5± 0.3mm(press coat tablet)

**Table 9 Evaluation for rapid release core**

| S. No | Physical parameter | F 1 | F 2 | F 3 | F 4 | F 5 | F 6 | F 7 | F 8 | F 9 | F10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Avg Weight (mg)** | 151 | 150 | 148 | 149 | 152 | 150 | 150 | 149 | 148 | 149 |
| 2 | **Hardness(Kg/$cm^2$)** | 5.1 | 5.3 | 5.6 | 5.1 | 5.2 | 5.3 | 5.4 | 5.7 | 5.8 | 5.4 |
| 3 | **Thickness(mm)** | 3.51 | 3.48 | 3.51 | 3.5 | 3.5 | 3.47 | 3.49 | 3.52 | 3.61 | 3.55 |
| 4 | **Friability %** | 0.33 | 0.46 | 0.41 | 0.50 | 0.54 | 0.45 | 0.35 | 0.39 | 0.37 | 0.45 |
| 5 | **Disintegration time** | 3min 42sec | 3min 52sec | 3min 4sec | 3min 21sec | 2min 16sec | 2min 08sec | 4min 34sec | 3min 48sec | 3min 26sec | 3min 25sec |

**Invitro dissolution studies for core and press coated tablets:-**

In vitro dissolution for core tablets were done in 6.8 phosphate buffer and enteric press coated tablets were initially placed in acidic stage and next was changed with phosphate buffer.

**Table No 10 Dissolution for core tablet**

| Dissolution time(Min) | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 |
|---|---|---|---|---|---|---|---|---|---|
| **5** | 14.4 | 16.2 | 16.1 | 10.4 | 12.1 | 19.1 | 15.0 | 16.4 | 20.4 |
| **10** | 22.4 | 30.5 | 10.8 | 18.4 | 22.1 | 35.4 | 24.1 | 28.9 | 27.8 |
| **20** | 37.3 | 40.1 | 46.8 | 35.4 | 51.7 | 65.4 | 45.6 | 48.6 | 33.5 |
| **30** | 52.4 | 73.9 | 73.4 | 60.4 | 66.3 | 76.1 | 66.6 | 61.4 | 41.6 |
| **45** | 76.0 | 79.4 | 80.3 | 72.6 | 75.4 | 82.0 | 75.4 | 72.4 | 60.4 |
| **60** | 80.1 | 82.2 | 85.4 | 81.5 | 88.7 | 97.6 | 80.4 | 79.6 | 77.6 |

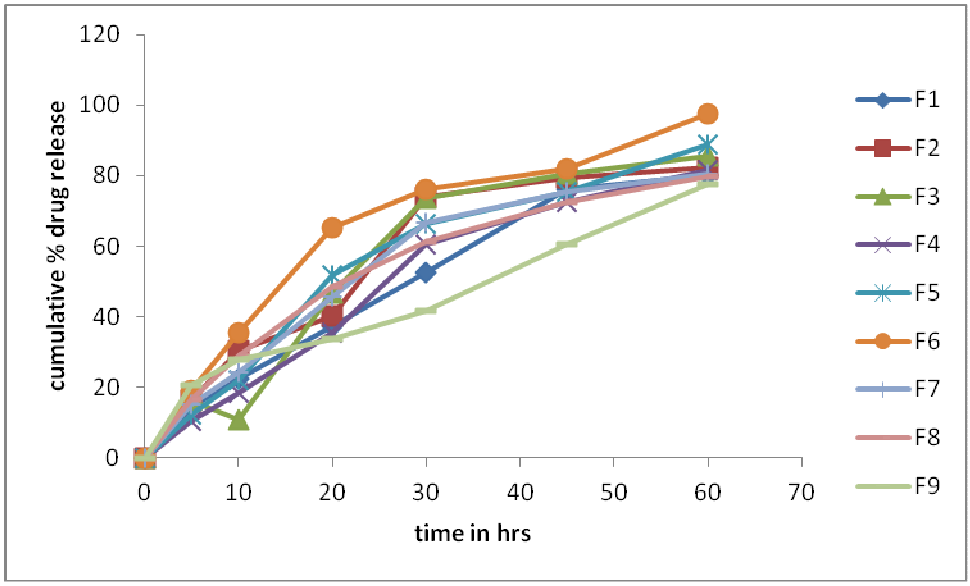


**Figure No 4 Dissolution graph for formulations F1-F9**

## Evaluation for Press coated tablets

**Table No 11**

| S. No | Physical parameter | P1F6 | P2F6 | P3F6 | P4F6 | P5F6 |
|---|---|---|---|---|---|---|
| 1 | **Avg Weight (mg)** | 551 | 550 | 549 | 549 | 550 |
| 2 | **Hardness (Kg/cm$^2$)** | 7.4 | 7.0 | 7.7 | 7.4 | 7.5 |
| 3 | **Thickness (mm)** | 2.45 | 2.49 | 2.5 | 2.51 | 2.5 |
| 4 | **Friability %** | 0.5 | 0.45 | 0.46 | 0.36 | 0.24 |

**Table No 12 Dissolution for Enteric press coat**

| Time in hrs | P1F6 | P2F6 | P3 F6 | P4 F6 | P5 F6 |
|---|---|---|---|---|---|
| | **0.1N HCL** | | | | |
| **1** | 0 | 0 | 0 | 0 | 0 |
| **2** | 0 | 0 | 0 | 0 | 0 |
| | **6.8 pH Phosphate buffer** | | | | |
| 3 | 8 | 19 | 6 | 4 | 7 |
| 4 | 15 | 30 | 8.9 | 16 | 18 |
| 5 | 19 | 54 | 15.3 | 29 | 25 |
| 6 | 22 | 79 | 20.5 | 42 | 33 |
| 7 | 39 | 81 | 48.9 | 72 | 40 |
| 8 | 79 | 94 | 98.4 | 92 | 75 |

**GRAPH FOR ENTERIC PRESS COAT FORMULATION**

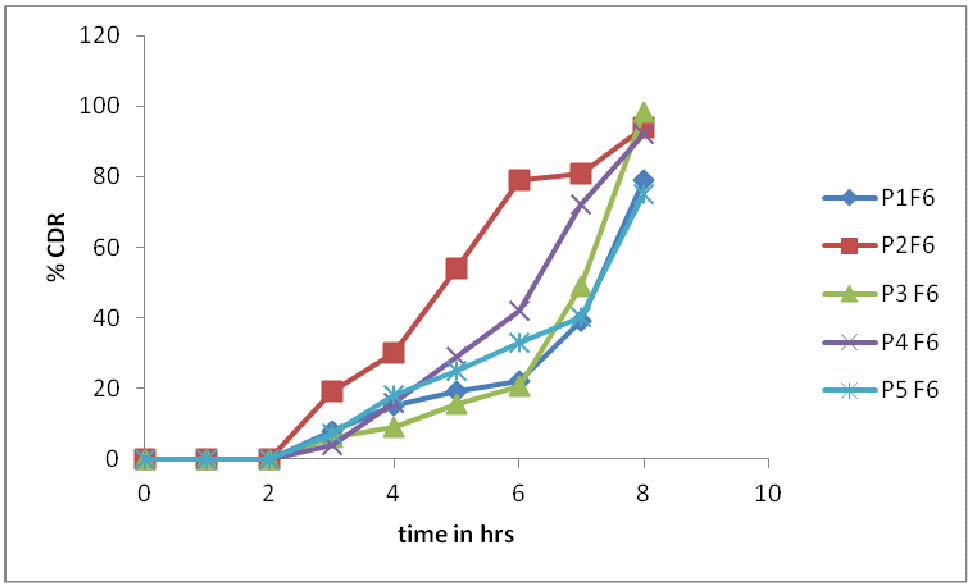


**Figure No 5- Graph showing % CDR verses time in hrs for formulations P1F6 to P5F6**

**Kinetics of *In Vitro* Drug Release:**

The dosage forms most commonly release the drug either in the zero order or in the first order pattern. Controlled release dosage forms of esomeprazole were prepared and studied for their dissolution behavior. *In vitro* release data of time points between 1 to 24 hours were considered and treated for kinetic principles.

The regression values of release kinetics of optimized formulation were shown in the table no. 13.

**Table no.13 : Regression values of release kinetics**

| 0.1 N HCl | | 4.5 Acetate buffer | 6.8 phosphate buffer |
|---|---|---|---|
| Zero order | 0.9263 | 0.921 | 0.8475 |
| First order | 0.8792 | 0.8957 | 0.7986 |
| Higuchi | 0.9922 | 0.9928 | 0.965 |
| Korsmeyer-Peppas | 0.9873 | 0.9809 | 0.9588 |
| Hixson-Crowell | 0.9461 | 0.9814 | 0.9058 |

The regression values of zero order are higher than the regression values of first order indicating that the release of drug is independent of the concentration. When the regression values of Higuchi, Korsmeyer-Peppas, and Hixson-Crowell were considered, the regression values were higher for Higuchi in all three mediums. It indicated that the drug was released through diffusion mechanism from the dosage form.

## CONCLUSION

Suitable analytical method based on UV-Visible spectrophotometer was developed for esomeprazole $\lambda_{max}$ of 285 nm was identified in 0.1N HCl solution,4.5 acetate buffer solution and 6.8 phosphate buffer solution.

FT-IR spectra interference was verified and found that esomeprazole did not interfere with the excipients used.

Press coated tablets of esomeprazole (F-I- F-IX) were successfully prepared using enteric coated polymers ethyl cellulose and HPMC pthallate by first preparing the core tablets and then press coated with polymers. The tablets were evaluated for physical properties and *in-vitro* dissolution studies. Based on the results, F-6 was identified as better formulation amongst all formulations.

*In vitro* release profiles of optimized formulation of esomeprazole colon specific release tablets (F-6) were found to be improvised to that of reference drug release profile i.e., 100 % drug release was achieved..The manufacturing procedure was standardized and found to be reproducible.

esomeprazole release from the tablets of F-6 formulation followed zero - order kinetics, hence the release of the drug from the dosage form was independent of concentration and followed Higuchi model, and hence release of drug from matrix was by diffusion mechanism.

By this we can conclude that the colon specific drug release formulation of esomeprazole developed is the promising system for the treatment of stomach and intestinal ulcers

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