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# FORMULATION AND EVALUATION OF SUMATRIPTAN SUCCINATE FAST DISSOLVING TABLETS

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## ABSTRACT
The aim of this investigation was to develop fast dissolving tablet of Sumatriptan Succinate A combination of super disintegrants, i.e., sodium starch glycolate (SSG) and crosscarmellose sodium (CCS) were used along with camphor as a subliming material. An optimized concentration of camphor was added to aid the porosity of the tablet. A $3^2$ full factorial design was applied to investigate the combined effect of two formulation variables: Amount of SSG and CCS. Infrared (IR) spectroscopy was performed to identify the physicochemical interaction between drug and polymer. IR spectroscopy showed that there is no interaction of drug with polymer. In the present study, direct compression was used to prepare the tablets. The powder mixtures were compressed into tablet using flat face multi punch tablet machine. Camphor was sublimed from the tablet by exposing the tablet to vacuum drier at 60°C for 12 hours. All the formulations were evaluated for their characteristics such as average weight, hardness, wetting time, friability, content uniformity, dispersion time (DT), and dissolution rate. An optimized tablet formulation (F 9) was found to have good hardness of 3.30 ± 0.10 kg/cm$^2$, wetting time of 42.33 ± 4.04 seconds, DT of 34.67 ± 1.53 seconds, and cumulative drug release of not less than 99% in 16 minutes.

**KEYWORDS:** Sumatriptan Succinate, contour plot, factorial design, orally disintegrating tablet, wetting time, water absorption ratio.

## INTRODUCTION
The tablet is the most widely used dosage form because of its convenience in terms of self-administration, compactness, and ease in manufacturing. However, geriatric and pediatric patients experience difficulty in swallowing conventional tablets, which leads to poor patient compliance. To overcome this weakness, scientists have developed innovative drug delivery systems known as “melt in mouth” or “mouth dissolve (MD)” tablets. These are novel types of tablets that disintegrate/dissolve/disperse in saliva. Their characteristic advantages such as administration without water, anywhere, anytime, lead to their suitability to geriatric and pediatric patients. They are also suitable for the mentally ill, the bedridden, and patients who do not have easy access to water. The benefits, in terms of patient compliance, rapid onset of action, increased bioavailability, and good stability, make these tablets popular as a dosage form of choice in the current market.[1,2]

A broad range of drugs (cardiovascular, analgesics, narcoleptics, antihistamines, and antibiotics) can be considered candidates for this dosage form. Fast dissolving tablets are formulated by techniques like tablet molding,[3] spray drying,[4] lyophilization,[5] sublimation,[6] and addition of disintegrants.[7] Some of the patented technologies for preparation of fast dissolving tablets are Zydis,[8,9] OraSolv,[10] DuraSolv, Flash Dose,[11] Wow tab (Without Water), and Flashtab.[12]

The Objective of this study was to formulate directly compressible orally disintegrating tablets of Sumatriptan Succinate. Sumatriptan is belongs to BCS-III Category. Pharmacologically is serotonin receptor agonist which commonly used to treat migraines and sometimes cluster headaches Sumatriptan Succinate is rapidly absorbed after oral dose. Peak plasma concentration occurs .30 to 1 hours and its plasma half-life is about is about 1.9 hours after an oral dose. It is water insoluble and tasteless. Therefore, it was selected as a model drug for the preparation of mouth dissolving tablets.[13]

## MATERIALS AND METHODS
Sumatriptane. Mg. stearate, Talc, Crospovidone (polyplasdone XL-10), Crosscarmellose sodium, (Ac-di-sol), Sodium starch glycolate, Aspartame, Peppermint oil AL Grade were purchased from the Merck. and instruments like Sensitive Electronic Balance, UV-Visible Spectrophotometer, 16 Station Tablet Rotary Press, Monsanto Hardness Tester Friability Test

Apparatus, Vernier Caliper, Tablet Disintegration Tester, Dissolution Apparatus, Hot Air Oven, Petridish, Ultra sonic bath sonicator.

**PREFORMULATION STUDIES[14-17]**

Preformulation testing is the first step in the rational development of dosage forms of a drug. It can be defined as an investigation of physical and chemical properties of drug substance, alone and when combined with excipients. A complete evaluation of physicochemical properties may provide a rationale for designing formulation or support the need for molecular modification or merely confirm that there are no significant barriers to the compound development.

The goals of the preformulation studies are:

- To establish the necessary physicochemical characteristics of a new drug substance.
- To determine kinetic release rate profile.
- To establish its compatibility with different excipients.

**1. Identification tests**

**IR Spectroscopy**

Identification of Sumatriptane was carried out by Infrared Absorption Spectroscopy.

**2. Compatibility studies**

The compatibility of drug and polymers under experimental condition is important prerequisite before formulation. It is therefore necessary to confirm that the drug does not react with the polymer and excipients under experimental condition and affect the shelf life of product.

This is confirmed by Infrared light absorption scanning spectroscopy. It is most powerful technique for chemical identification of drug.

Method: The pure drug and its formulation were subjected to IR studies. In the present study, the potassium bromide disc (pellet) method was employed.

**Standard calibration curve**

**Preparation of 6.8 pH phosphate buffer solution**

27.22g of monobasic potassium phosphate was weighed and diluted up to 1000 ml to get stock solution of monobasic potassium phosphate. 8g Sodium hydroxide was weighed and diluted up to 1000ml to get 0.2M sodium hydroxide solution. 50 ml of the monobasic potassium phosphate solution was taken from the stock solution in a 200-mL volumetric flask and 22.4 ml of sodium hydroxide solution from stock solution of 0.2M sodium hydroxide solution was added and then water was used to make up the volume.

**Preparation of standard calibration curve of Sumatriptane**

The stock solution was prepared by adding 10 mg of drug in few ml of methanol and make up the volume to 100ml with methanol from this stock-1 take 1ml and make up the volume to 10ml with phosphate buffer pH 6.8. From this solution serial dilutions were performed to prepare 2-10 µg/ml of drug concentration were made using same buffer solutions. All samples were analyzed by UV spectrophotometer by measuring the absorbance at 221 nm.

**IR spectral analysis**

Infrared spectra of Sumatriptane, PVP and its inclusion complexes were recorded by KBr method using Fourier Transform Infrared Spectrophotometer.

Method: In the present study, the potassium bromide disc method was employed. The powdered sample was intimately mixed with dry powdered potassium bromide. This mixture was then compressed into transparent disc under high pressure using special dies. This disc was placed in IR spectrometer and spectrums were recorded. The scanning range was 450–4000 cm−1 and the resolution was 1 cm−1.

**Formulation of fast dissolving tablet of Sumatriptane**

Fast dissolving tablets were prepared by direct compression using sumatriptane succinate, The formula included variable amounts of superdisintegrants those are F1, F2 (with Sodium starch glycollate- 3%, 6%), F3, F4 (with Crosscaramellose sodium-3%, 6%), F5, F6 (with Crospovidone-3%, 6%), and other excipients. The amount of sumatriptane succinate equivalent to 25 mg of drug per tablet were taken and then mixed with directly compressible diluents and superdisintegrant in a mortar with the help of pestle, then finally Aspartame as sweeter and mg stearate, talc as lubricants were added. The blend was then compressed using 6 mm flat-faced punch using a tablet compression machine. The total Batch size was 25 tablets and total weight of the tablet was maintained 100mg.

**Table 1: Formulation of fast dissolving tablet of Sumatriptane.**

| Ingredients (mg per each tablet) | Formulations Codes | | | | | |
|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 | F6 |
| Sumatriptan succinate | 25 | 25 | 25 | 25 | 25 | 25 |
| Crospovidone | ----- | ----- | ---- | ------ | 3 | 6 |
| Croscarmellose sodium. | ------ | ------ | 3 | 6 | ----- | ----- |
| SSG | 3 | 6 | ---- | ------- | ------ | ----- |
| MCC 101 | 62 | 59 | 62 | 59 | 62 | 59 |
| Aspartame | 4 | 4 | 4 | 4 | 4 | 4 |
| Pippermint oil | 1 | 1 | 1 | 1 | 1 | 1 |
| Magnesium stearate | 3 | 3 | 3 | 3 | 3 | 3 |
| Talc | 2 | 2 | 2 | 2 | 2 | 2 |

**Evaluation of Tablets[18-20]**

**Pre-compression parameters**

Prior to the compression, the powder blends of various batches were evaluated for their bulk and tapped density and from these values compressibility index and Hausner's ratio were calculated. While the flow properties of the powder bled were accessed from the angle of repose. The evaluation parameters were studied before and after addition of lubricants to check and compare the inherent flow properties of powders.

**Bulk density and Tapped Density**

Both loose bulk density (LBD) and tapped bulk density (TBD) were determined. The accurately weighed amount of sample taken in a 25ml measuring cylinder of Borosil measured/recorded the volume of packing and tapped 100 times on a plane hard wooden surface and tapped volume of packing recorded and LBD and TBD calculated by following formula:

***Tapped density*** *= Wt. of sample in gm / Tapped volume*

***Bulk density*** *= weight of sample in gram /volume occupied by the sample*

$$\text{Carr's index} = \frac{\text{Tapped desnity} - \text{Bulk density}}{\text{Tapped density}} \times 100$$

**Hausner's ratio**

The Hausner's ratio is a number that is correlated to the flowability of a powder or granular material.

***Hauser's Ratio*** *= Tapped Density / Bulk Density*

III. Compressibility index:

Percent compressibility of powder mix was determined by Carr's

Compressibility index calculated by following formula.

**Table 2: Flow properties according to Carr's Index Hausner's ratio.**

| Carr's Index (%) | Flow Character | Hausner's Ratio |
|---|---|---|
| ≤ 10 | Excellent | 1.00–1.11 |
| 11–15 | Good | 1.12–1.18 |
| 16–20 | Fair | 1.19–1.25 |
| 21–25 | Passable | 1.26–1.34 |
| 26–31 | Poor | 1.35–1.45 |
| 32–37 | Very poor | 1.46–1.59 |
| >38 | Very, very poor | >1.60 |

I. Angle of repose (θ)

The frictional forces in a loose powder or granules can be measured by the angle of repose. This is the maximum angle possible between the surface of a pile of powder or granules and the horizontal plane.

$\tan \theta = h/r$

$\theta = \tan^{-1} (h/r)$

Where, θ is the angle of repose

h is the height

r is the radius.

**Table 3: Flow Properties and Corresponding Angles of Repose.**

| Flow Property | Angle of Repose (degrees) |
|---|---|
| Excellent | 25–30 |
| Good | 31–35 |
| Fair - aid not needed | 36–40 |
| Passable - may hang up | 41–45 |
| Poor - must agitate, vibrate | 46–55 |
| Very poor | 56–65 |
| Very, very poor | >66 |

**Post-compression parameters[15-20]**

***I. Shape and colour of tablets***

Uncoated tablets were examined under a lens for the shape of the tablet, and colour was observed by keeping the tablets in light.

***II. Uniformity of thickness***

Three tablets were picked from each formulation randomly and thickness was measured individually. It is expressed in mm and standard deviation was also calculated. The tablet thickness was measured using dial-caliper (Mitutoyo, Japan).

***III. Hardness test***

Hardness indicates the ability of a tablet to withstand mechanical shocks while packaging, handling and transportation. The hardness of the tablets was determined using Monsanto hardness tester. It is expressed in kg/cm$^2$. Three tablets were randomly picked and analyzed for hardness. The mean and standard deviation values were calculated.

***IV. Friability test***

It is the phenomenon whereby tablet surfaces are damaged and/or show evidence of lamination or breakage when subjected to mechanical shock or attrition. The friability of tablets was determined using Roche Friabilator. It is expressed in percentage (%). Ten tablets were initially weighed ($W_{initial}$) and transferred into friabilator. The friabilator was operated at 25 rpm for 4 minutes or run up to 100 revolutions. The tablets were weighed again ($W_{final}$). The % friability was then calculated by,

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

% Friability of tablets less than 1% are considered acceptable.

***V. Weight variation test***

Ten tablets were selected randomly from each batch and weighed individually to check for weight variation. A little variation is allowed in the weight of a tablet by U.S. Pharmacopoeia. The following percentage deviation in weight variation is allowed.

**Table 4:** ***Weight variation test.***

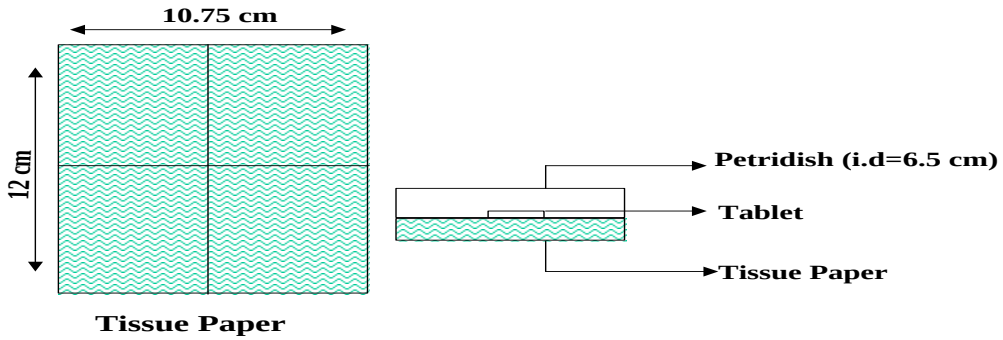
| Average weight of a tablet | Percentage deviation |
|---|---|
| 130 mg or Less | ±10 |
| More than 130 mg and less than 324 mg | ±7.5 |
| 324 mg or More. | ±5 |

***VI. Drug content uniformity***[21-23]

Tablet containing 25 mg of drug is dissolved in 100ml of Phosphate buffer pH 6.8. The drug is allowed to dissolve in the solvent, the solution was filtered and 1ml of filtrate was taken in 10 ml of volumetric flask and diluted up to the mark with phosphate buffer pH 6.8 and analyzed spectrophotometrically at 221 nm. The amount of Sumatriptane was estimated by using standard calibration curve of the drug. Drug content studies were carried out in triplicate for each batch of formulation.

***VII. Wetting time***

The method was applied to measure tablet-wetting time. A piece of tissue paper folded twice was placed in a small Petridish (i.d. = 6.5 cm) containing 6 ml of water, a tablet was put on the paper, and the time for complete wetting was measured. Three trials for each batch were performed and standard deviation was also determined.




**Simple method for the measurement of wetting time of a tablet.**

***Water absorption ratio***

A piece of tissue paper folded twice was placed in a small Petridish containing 6ml of distilled water. A tablet was put on the paper and time required for complete wetting was measured. The wetted tablet was then weighed. Water absorption ratio, R, was determined using equation –

$$R = 100 \times Wa - Wb/Wb$$

Where,
Wb = weight of the tablet before water absorption
Wa = weight of the tablet after water absorption

Three tablets from each formulation were performed and standard deviation was also determined.

***VII. In vitro disintegration time***

The process of breakdown of a tablet into smaller particles is called as disintegration. The *in vitro* disintegration time of a tablet was determined using disintegration test apparatus as per I.P. specifications.

Place one tablet in each of the 6 tubes of the basket. Add a disc to each tube and run the apparatus using pH 6.8 (simulated saliva fluid) maintained at $37^0 \pm 0.5^0$C as the immersion liquid. The assembly should be raised and lowered between 30 cycles per minute in the pH 6.8 maintained at $37^0 \pm 0.5^0$C. The time in seconds taken for complete disintegration of the tablet with no palpable mass remaining in the apparatus was measured and recorded.

***VIII. In vitro dispersion time***

*In vitro* dispersion time was measured by dropping a tablet in a measuring cylinder containing 6 ml of pH 6.8 (simulated saliva fluid). Three tablets from each formulation were randomly selected and *in vitro* dispersion time was performed. Standard deviation was also determined and *in vitro* dispersion time is expressed in seconds.

***IX. In vitro dissolution studies*[24]**

*In vitro* release studies were carried out using tablet dissolution test apparatus USP XXIII. Two objectives in the development of *in vitro* dissolution tests are to show (1) that the release of the drug from the tablet is as close as possible to 100% and (2) that the rate of drug release is uniform from batch to batch and is the same as the release rate from those batches proven to be bioavailable and clinically effective.

**The following procedure was employed throughout the study to determine the *in vitro* dissolution rate for all the formulations**

**Table 5:** ***In vitro dissolution studies Parameters.***

| PARAMETERS | CONDITIONS |
|---|---|
| Dissolution medium | 900 ml of pH 6.8 Phosphate buffer solution |
| Temperature | $37^0$C$\pm 0.5^0$C |
| RPM | 75 rpm |
| Tablet taken | One tablet (Known drug content). |
| Volume withdrawn | 5 ml every 2 minutes |
| $\lambda_{max}$ | 221 nm |
| Beer's range | 2-12 µg/ml |
| Time duration of the study | 15mins |

The various parameters related to dissolution which are evaluated in the present work are as follows:

1. Drug release
2. Cumulative percentage drug release
3. Cumulative percentage drug retained.

***XII. Curve fitting analysis***

The mechanism of Sumatriptane succinate released from the fast dissolving tablets was studied by fitting the dissolution data in different models.

**Zero order kinetics**

Drug dissolution from pharmaceutical dosage forms that do not disaggregate and release the drug slowly, assuming that the area does not change and no equilibrium conditions are obtained can be represented by the following equation,

$Q_t = Q_o + K_o t$

Where

$Q_t$ = amount of drug dissolved in time t.
$Q_o$ = initial amount of the drug in the solution and
$K_o$ = zero order release constant.

**First order kinetics**

To study the first order release rate kinetics, the release rate data were fitted to the following equation,

$\text{Log } Q_t = \log Q_o + K_1 t/2.303$

Where $Q_t$ is the amount of drug released in time t, $Q_o$ is the initial amount of drug in the solution and $K_1$ is the first order release constant.

**Stability Study**[25]

Stability of a drug has been defined as the ability of a particular formulation, in a specific container, to remain within is physical, chemical, therapeutics and toxicological specifications. Stability studies were conducted for the optimized enteric coated pellet formulation. The reason for selection is, formulation have shown good results in in-vitro drug release studies. The stability was performed as per following.

**Preliminary stability of the optimized batch**

The optimized batch was charged on accelerated stability as per ich guidelines.

Optimised formulation were packed and stored in ICH certified stability chambers maintained at i) 25°C and 60% RH II) 40°C and 75% RH for three months. The pellets are withdrawn periodically and evaluated for the friability, colour, diameter, drug content and in-vitro release studies.

**Table 6: Stability protocol of ICH Guidelines.**

| S. No | Study | Storage condition | Duration |
|---|---|---|---|
| **1** | Long term | 25°C ± 2°C / 60% RH ± 5% RH | 12 months |
| **2** | Intermediates | 30°C ± 2°C / 60% RH ± 5% RH | 6 months |
| **3** | Accelerated | 40°C ± 2°C / 75% RH ± 5% RH | 6 months |

## RESULTS AND DISCUSSION

### 5.1 Preformulation studies

**1. Identification of pure drug**

The IR spectrum of pure drug was found to be similar to the standard spectrum of Sumatriptane succinate. The spectrum of the Sumatriptane succinate shows the following functional groups at their frequencies.

**2. Compatibility studies**

From the spectra of pure drug Sumatriptane and the combination of drug with polymers, it was observed that all the characteristic peaks of Sumatriptane succinate were present in the combination spectrum, thus indicating compatibility of the drug and polymer. IR spectra of the pure drug and in combination with the polymers are shown.

### 5.2 Standard calibration curve for Sumatriptane succinate

**Preparation of Stock solution with 6.8 PH Phosphate Buffer**

Stock I: 100mg of the drug was accurately weighed and transferred into the 100 ml volumetric flask. It was dissolved in sufficient quantity of phosphate buffer and volume was made up to the mark with phosphate buffer to get a 1000 µg/ml solution. This was the standard stock solution containing 1 mg/ml of model drug. (Stock I).

**UV Absorption Maxima (λ max) of drug sample in 6.8 PH Phosphate Buffer**

Stock II: One ml of the above solution was then further diluted to 100 ml with phosphate buffer to get a stock solution of 10µg/ml. UV scanning was done for 10 µg/ml drug solution from 200-400 nm using 6.8pH phosphate buffer as a blank in schimadzu, UV 2450 spectrophotometer. The wavelength maximum was found to be at 226 nm.

**Preparation of the calibration curve**

From the stock II solution 2, 4, 6, 8 and 10ml were transferred to 10 ml volumetric flasks and were diluted with the phosphate buffer, up to the mark to obtain concentration of 2, 4, 6, 8 and 10µg/ml respectively. Absorbance of each solution was measured at 221 nm. The Standard curve preparation was performed. The absorbances were plotted against the concentrations and the graph with the straight-line equation and r2 value were obtained 0.998.

**Table 7: Calibration curve of sumatriptan succinate.**

| Concentration (µg/ ml) | Absorbance |
|---|---|
| 0 | 0 |
| 2 | 0.206 |
| 4 | 0.398 |
| 6 | 0.656 |
| 8 | 0.842 |
| 10 | 1.044 |

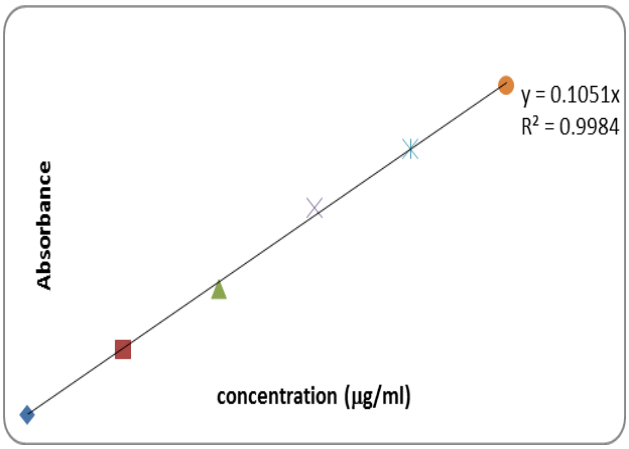



**Figure 1: Calibration Curve of Sumatriptan Succinate with 6.8pH Phosphate Buffer.**

**Characterization of Sumatriptane succinate ODT Tablets**

IR spectra of inclusion complexes of Sumatriptan succinate with superdisintegrants. It was suggested that vibrating and bending movements of guest molecule i.e. Sumatriptane were restricted due to formation of inclusion complexes. It may be the aromatic ring portion of Sumatriptane succinate.

**Formulation development of fast dissolving tablet**

Fast dissolving tablets of Sumatriptane succinate were prepared using direct compression method. Before compression, the powder blends were subjected to Precompression evaluation to determine the flow properties and the compressibility. The results of the Precompression evaluation are as given below.

**Evaluation of Tablets**

**Pre-compression parameters**

**I. Angle of repose (θ )**

The results obtained for angle of repose of all the formulations. The values were found to be in the range of $27^0$.32' to $30^0$.17'. All formulations showed the angle of repose within $30^0$, which indicates a good flow property of the granules. The values obtained are recorded in Table 8.

***II.* Bulk density and tapped density**

Both loose bulk density (LBD) and tapped bulk density results are shown in Table 11. The loose bulk density and tapped bulk density for all the formulations varied from 0.55 gm/cm$^3$ to 0.60gm/cm$^3$ and 0.67 gm/cm$^3$ to 0.73gm/cm$^3$ respectively. The values obtained lies within the acceptable range and not large differences found between loose bulk density and tapped bulk density. This result helps in calculating the % compressibility of the powder. The values obtained are recorded in Table 8.

***III. Hausner's ratio***

The result obtained for hausner's ratio of all formulations. The values were found to be in the range of 1.152 - 1.218. All formulations showed the hausner's ratio within the range, which indicates a good flow property of the granules. The values obtained are recorded in Table 8.

***IV. Percentage compressibility***

This percent compressibility of powder mix was determined by Carr's compressibility index. The results obtained for percentage compressibility. The percent compressibility for all the nine formulations lies within the range of 13.23 to 15.49. All formulations are showing good compressibility. The values obtained are recorded in Table 8.

**Post-compression parameters**

All the tablet formulations were subjected for evaluation according to various official specifications and other parameters. Shape, thickness, hardness, friability, weight variation, *in vitro* disintegration time, wetting time, water absorption ratio, drug content, *in vitro* dissolution studies, model fitting of release profile and stability studies were carried out.

***I. Shape and color of tablets***

Randomly picked tablets from each formulation batch examined under lens for shape and in presence of light for color. All tablets of all the batches showed flat, circular in shape and white in color.

***II. Uniformity of thickness***

The thickness of the tablets was measured by using dial caliper by picking the tablets randomly. The mean values are shown in Table 1. The values are almost uniform in all formulations. Thickness was found in the range of 2.43 mm to 2.62 mm respectively.

***III. Hardness test***

Hardness test was performed by Monsanto hardness tester. Hardness was found to be within 3.87 kg/cm$^2$ to 4.70 kg/cm$^2$, as these tablets are rapidly disintegrating. The lower standard deviation values indicated that the hardness of all the formulations were almost uniform in specific method and possess good mechanical strength with sufficient hardness. The values obtained are recorded in Table 9.

***IV. Friability test***

The study results are tabulated in Table 12, was found well within the approved range (<1%) in all the formulations. Formulation F1 to F12 possesses good mechanical strength. The values obtained are recorded in Table 9.

***V. Weight variation test***

The percentage weight variation for all the formulation is tabulated in Table 12. All the tablets passed weight variation test as the % weight variation was within the pharmacopoeial limits of ±10 %. It was found to be from 298.9 to 301.0 mg. The weight of all the tablets was found to be uniform. The values obtained are recorded in Table 9.

***VI. Drug content uniformity***

The content uniformity was performed for all the formulations and results are shown in Table 12. Five trials from each formulation were analyzed spectrophotometrically. The mean value and standard deviation of all the formulations were calculated. The drug content of the tablets were found between 4.742±0.031 mg to 5.097±0.023 mg of Sumatriptan succinate. The results indicated that in all the formulations the drug content was uniform. The cumulative percentage drug released by each tablet in the *in vitro* release studies were based on the mean content of the drug present in the respective tablet. The values obtained are recorded in Table 9.

***VII. Wetting time***

Wetting time is closely related to the inner structure of tablets. The result of the wetting time is shown in Table 13. All formulation showed quick wetting. This may be due to ability of swelling and also capacity of absorption of water. All superdisintegrants have high water absorption capacity and cause swelling. This parameter also duplicates disintegration time in oral cavity, as tablet is kept motionless on tongue; hence correlation between wetting time and disintegration time in oral cavity can also be made. The values obtained are recorded in Table 10.

***VIII. Water absorption ratio***

Water absorption ratio, which is an important criterion for understanding the capacity of disintegrants to swell in presence of little amount of water, was calculated. It was found to be in the range of 56.64 ± 1.163 to 65.04 ± 1.236. The values obtained are recorded in Table 10.

The Water absorption ratio increased with increase in the concentration of superdisintegrant from 3-5%. There existed a direct relationship for each of Sumatriptane succinate fast dissolving tablets formulation. This increase was due to the water up taking ability of the superdisintegrants. More the superdisintegrant concentration greater was the water uptake and thereby increase in water absorption.

***IX. In vitro disintegration time***

Internal structure of the tablets that is pore size distribution, water penetration into tablets and swelling of disintegration substance are suggested to be the mechanism of disintegration. This was determined as per I.P. procedure for all the formulations. All formulations showed disintegration time less than 30 seconds. Among the three superdisintegrants used, crospovidone showed less disintegrating time followed by crosscarmellose sodium and sodium starch glycolate. The values obtained are recorded in Table 10.

***X. In vitro dispersion time***

*In vitro* dispersion time gives direct information regarding the nature of super-disintegrating agent used in the formulations. *In vitro* dispersion time is measured by observing the time taken by the tablets to undergo uniform dispersion in pH 6.8 buffer. Rapid dispersion of the tablets was observed in all the formulations. This indicate that the efficiency of superdisintegrants was in the order crospovidone > crosscarmellose > sodium starch glycolate. The values obtained are recorded in Table 10.

***XI. In vitro dissolution studies***

All the twelve formulations were subjected for the *in vitro* dissolution studies using tablet dissolution tester USP XXIII. The samples were withdrawn at different time intervals and analyzed at 226 nm. Cumulative drug release were calculated on the basis of mean amount of Sumatriptane succinate present in the respective tablet. The results obtained in the *in vitro* drug release for the formulations are tabulated in table 4. The plots of cumulative % drug release V/s. time are shown in Figure 4-6.

**Table 8: Angle of repose, loose bulk density, Tapped bulk density, Carr's compressibility index, Hausner's ratio.**

| Formulation Code | Uniformity of Thickness (n=3) (mm) | Hardness (n=3) (kg/cm$^2$) | Friability % (n=10) | Uniformity of Weight (n=10) (mg) | Drug Content (n=3) (mg) |
|---|---|---|---|---|---|
| F1 | 2.57±0.01 | 3.90±0.19 | 0.2792 | 101.0±1.032 | 59.871±0.023 |
| F2 | 2.62±0.03 | 4.40±0.13 | 0.2866 | 100.5±2.151 | 58.903±0.067 |
| F3 | 2.51±0.05 | 4.70±0.21 | 0.3493 | 100.3±2.163 | 59.968±0.021 |
| F4 | 2.43±0.02 | 3.87±0.29 | 0.2834 | 99.7±2.88 | 59.742±0.031 |
| F5 | 2.47±0.01 | 4.30±0.23 | 0.3261 | 100.0±1.021 | 59.935±0.113 |
| F6 | 2.53±0.04 | 4.41±0.21 | 0.2451 | 01.0±1.021 | 60.00±0.046 |

**Table no 9: Physical Evaluation of Different formulations of Sumatriptane succinate Tablet.**

| Formulation code | Angle of Repose (θ) | Bulk Density (gm/cm$^3$) | Tapped Density (gm/cm$^3$) | Hausner's ratio | % Compressibility |
|---|---|---|---|---|---|
| F1 | 29.17 | 0.59 | 0.69 | 1.169 | 14.49 |
| F2 | 28.91 | 0.56 | 0.67 | 1.196 | 16.41 |
| F3 | 30.01 | 0.55 | 0.67 | 1.218 | 17.99 |
| F4 | 28.18 | 0.59 | 0.68 | 1.152 | 13.23 |
| F5 | 28.69 | 0.60 | 0.73 | 1.216 | 17.80 |
| F6 | 28.41 | 0.60 | 0.71 | 1.183 | 15.49 |

**Table 10: Wetting time, Water absorption ratio, *In Vitro* Disintegration time, *In Vitro* Dispersion time.**

| Formulation Code | Wetting Time (n=3) | Water Absorption Ratio (n=3) | *In vitro* Disintegration Time (Sec)* | *In vitro* DispersionTime (Sec.)* |
|---|---|---|---|---|
| | *Mean ± SD* | *Mean ± SD* | *Mean ± SD* | *Mean ± SD* |
| F1 | 35.01 ± 0.37 | 56.64 ± 1.163 | 25.30 ± 1.69 | 26.34 ± 0.86 |
| F2 | 33.74 ± 1.55 | 57.26 ± 1.712 | 20.43 ± 0.65 | 20.63 ± 1.48 |
| F3 | 28.53 ± 1.57 | 59.41 ± 2.531 | 19.21 ± 1.43 | 21.63 ± 1.51 |
| F4 | 35.60 ± 0.76 | 59.45 ± 2.144 | 15.68 ± 1.53 | 24.54 ± 1.15 |
| F5 | 27.28 ± 1.25 | 62.74 ± 0.671 | 17.64 ± 1.15 | 20.23 ± 1.78 |
| F6 | 20.21 ± 1.43 | 63.31 ± 1.121 | 14.38 ± 2.19 | 17.33 ± 1.24 |

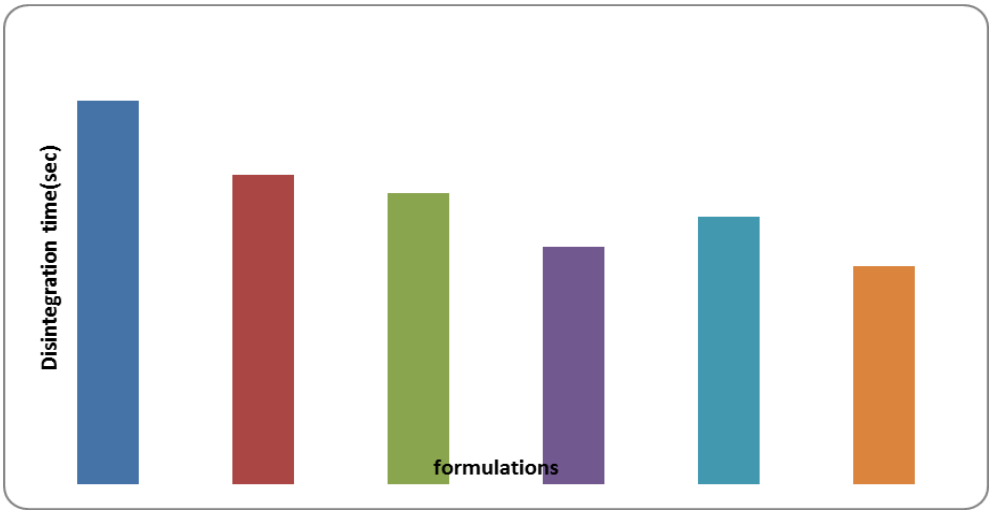



**Figure 2: Comparison of Disintegration times of different formulations (f1-f6).**

**DISSOLUTION STUDIES OF SUMATRIPTANE SUCCINATE FDTS**

**Table No 11: In vitro dissolution studies of the formulations in pH6.8 phosphate buffer.**

| S No | Trials | Mean percentage of Drug dissolved (in pH 6.8 phosphate buffer) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 mins | 2 mins | 4mins | 6mins | 8mins | 10 mins | 12mins |
| 1 | F1 | 0 | 45.99 | 55.47 | 72.30 | 76.68 | 85.74 | 87.89 |
| 2 | F2 | 0 | 50.99 | 62.57 | 73.65 | 82.18 | 88.12 | ------ |
| 3 | F3 | 0 | 48.97 | 57.87 | 72.43 | 79.76 | 88.57 | ------ |
| 4 | F4 | 0 | 52.17 | 62.45 | 77.32 | 85.43 | 90.83 | ----- |
| 5 | F5 | 0 | 54.49 | 67.21 | 72.79 | 82.87 | 91.04 | 93.6 |
| 6 | F6 | 0 | 58.96 | 72.71 | 80.65 | 84.9 | 97.98 | ---- |

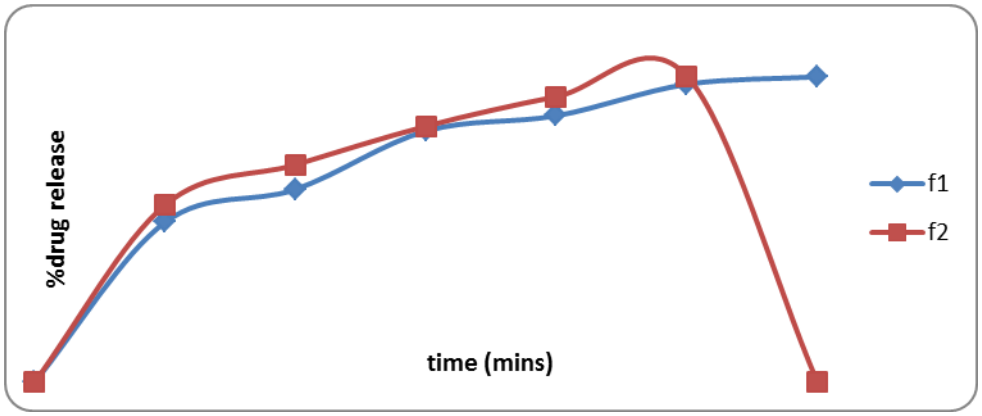



**Figure 3: Comparative dissolution graph for F1 & F2.**

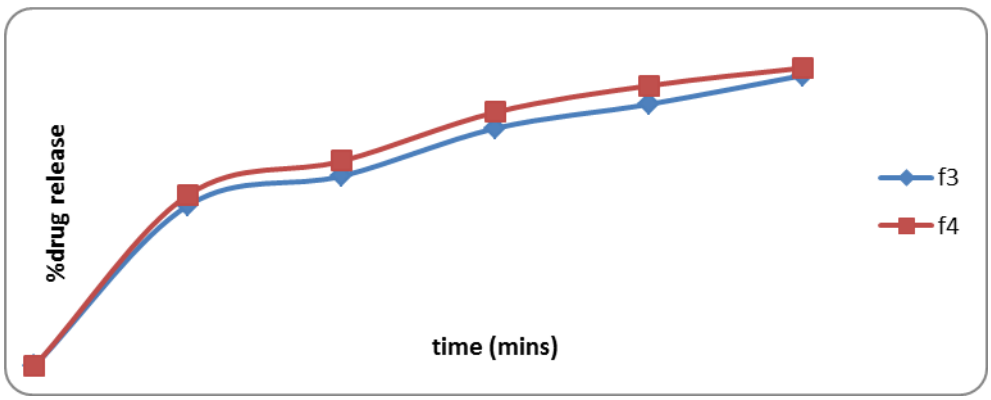



**Figure 4: Comparative dissolution graph for F3 & F4.**

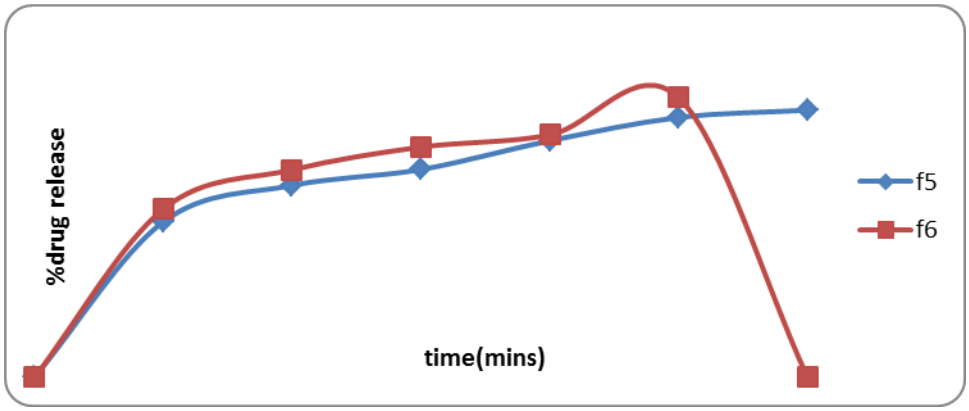



**Figure 5: Comparative dissolution graph for F5 & F6.**

**STABILITY DATA**

**Table No 12: Physicochemical parameters of Sumatriptane succinate tablets from formulation F6 at 25°C/60% RH.**

| PARAMETER | INITIAL | AFTER 1MONTH | AFTER 2 MONTHS | AFTER 3 MONTHS |
|---|---|---|---|---|
| **Description** | White colored tablet | White colored tablet | White colored tablet | White colored tablet |
| **Avg.Weight(mg)** | 101.2 | 101.2 | 100.9 | 99.9 |
| **Hardness(N)** | 4.41 | 4.40 | 4.38 | 4.38 |
| **Thickness(mm)** | 2.53 | 2.53 | 2.52 | 2.52 |
| **Friability (%)** | 0.2451 | 0.2450 | 0.2450 | 0.2451 |

**Table No 13: Physicochemical parameters of Sumatriptane succinate tablets from formulation F6 at 40°C/75% RH.**

| PARAMETER | INITIAL | AFTER 1MONTH | AFTER 2 MONTHS | AFTER 3 MONTHS |
|---|---|---|---|---|
| **Description** | White colored tablet | White colored tablet | White colored tablet | White colored tablet |
| **Avg.Weight(mg)** | 101.2 | 100.0 | 103.2 | 103.4 |
| **Hardness(N)** | 4.41 | 4.38 | 4.35 | 4.35 |
| **Thickness(mm)** | 2.53 | 2.53 | 2.53 | 2.52 |
| **Friability (%)** | 0.2451 | 0.2451 | 0.2452 | 0.2452 |

**Table No 14: Dissolution profiles of Sumatriptane succinate Tablets from formulation F6 at 25°C/60% RH.**

| TIME (hrs) | PERCENTAGE OF DRUG RELEASE | | | |
|---|---|---|---|---|
| | INITIAL | AFTER 1MONTH | AFTER 2 MONTHS | AFTER 3 MONTHS |
| 0 | 0 | 0 | 0 | 0 |
| 2 | 58.96 | 57.87 | 56.88 | 55.76 |
| 4 | 72.71 | 71.98 | 70.89 | 69.87 |
| 6 | 80.65 | 79.43 | 79.12 | 78.23 |
| 8 | 84.9 | 83.98 | 83.23 | 82.54 |
| 10 | 97.98 | 96.49 | 96.45 | 95.42 |

**Table No 15: Dissolution profiles of Sumatriptane succinate Tablets from formulation F6 at 40°C/75% RH.**

| TIME (hrs) | PERCENTAGE OF DRUG RELEASE | | | |
|---|---|---|---|---|
| | INITIAL | AFTER 1MONTH | AFTER 2 MONTHS | AFTER 3 MONTHS |
| 0 | 0 | 0 | 0 | 0 |
| 2 | 58.96 | 57.12 | 56.76 | 56.12 |
| 4 | 72.71 | 72.11 | 69.56 | 68.98 |
| 6 | 80.65 | 79.67 | 78.67 | 79.23 |
| 8 | 84.9 | 84.24 | 83.12 | 82.98 |
| 10 | 97.98 | 96.2 | 96.98 | 95.87 |

**SUMMARY**

A Fast dissolving dosage form has been developed as a user friendly formulation that disintegrates in mouth immediately within a minute without the need of water or chewing, as the tablet disintegrates in oral cavity, this could enhance clinical efficacy of drug through pregastric absorption from mouth, pharynx and esophagus, which leads to increase in bioavailability by avoiding first pass metabolism.

In present work, an effort is made to formulate and evaluate fast dissolving tablets of Sumatriptane succinate by Direct Compression method. Prepared Tablets were further examined through FTIR, studies showed that the drug carrier were compatible. These complexes were compressed into tablets by direct compression method using different superdisintegrant like crosspovidone (Polyplasdone XL-10), crosscarmellose, sodium stach glycolate (Explotab) in different concentration using aspartame as a sweetener.

Prepared tablets evaluated for Pre-compression parameters and post compression parameters.

Pre-compression parameters were carried out to determine the flow properties of granules. Bulk densities, tapped density, hausner's ratio, compressibility, angle of repose were determined for all the formulations, which showed good results indicating good flow properties.

Post-compression parameters were conducted for the tablets prepared by direct compression. The shape and colour of all the formulation were found to be circular and white in colour, and thickness of tablets also was uniform. Hardness, tensile strength and friability of tablets found to be fairly uniform for all the formulations and were well within the approved range (Indian Pharmacopoeial Standard).

All the batches of tablets, disintegrated within 30 seconds. The disintegration time for all the formulations indicates rapid disintegration. Disintegration time was decreased with the increase in the concentration of superdisintergrants. Formulation F6 **polyplasdone XL-10 (6%)** showed In-vitro disintegration time 14.38 sec. Water abortion ratio showed good absorptivity in all formulations.

Alternating concentrations of **sodium starch glycolate**, **Ac-di-sol (CCS)**, and **polyplasdone XL-10** had a significant influence on the release rate of drug. The In-vitro dissolution profiles of F1&F2 (Sodium starch glycolate- 3%, 6%) were found to be equivalent percentage of drug release 87.14% & 88.12% respectively up to 10 mins. The In-vitro dissolution profiles of F3&F4(Crosscaramellose sodium-3%, 6%) were found to be equivalent percentage of drug release 88.57% & 90.83% respectively up to 10 mins. The In-vitro dissolution profiles of F5&F6 (Crospovidone-3%, 6%), were found to be equivalent percentage of drug release 91.04% & 97.98% respectively up to 10 mins.

The stability studies were conducted for optimized formulation (F6) as per ICH guidelines at $25^0$C±2/60±5% RH and $40^0$C±2/75±5% RH for 3 months and no changes observed.

**CONCLUSION**

The fast dissolving tablets of Sumatriptane succinate were prepared by direct compression using different superdisintegrants such as **polyplasdone XL-10 (CP)**, **Ac-di-sol (CCS)**, **sodium starch glycolate** in different concentration. Preformulation studies of Sumatriptane succinate and excipients were performed. The FTIR analysis revealed that the Superdisintegrants and other exicipents used were compatible with Sumatriptan succinate. Disintegration time was decreased with the increase in the concentration of superdisintergrants. Among all formulation, formulation containing **polyplasdone XL-10 (CP)** as superdisintegrants is fulfilling all the parameters satisfactorily. It has shown excellent in vitro disintegration, *in vitro* dispersion time, compared to other superdisintegrants. The relative efficiency of these superdisintegrants to improve the disintegration and dissolution rates of tablets was in order

**polyplasdone XL-10 (CP)**> **Ac-di-sol (CCS)**> **sodium starch glycolate**.

*In-vitro* release studies revealed that almost drug was released from all the formulation were within 12 min. formulation F6 **polyplasdone XL-10 (6%)** showed faster drug release (97.98) within 10 minutes in comparison to other formulation.

Therefore, it may be concluded that direct compression process is simple, reproducible and robust to prepare fast disintegrating tablets of sumatriptan succinate and other anti-migraine drugs.

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