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FORMULATION AND EVALUATION OF HARD GELATIN CAPSULE OF POMALIDOMIDE

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Abstract:
The present study was undertaken with the objective of formulating and evaluating hard gelatin capsules of Pomalidomide for oral drug delivery. Pomalidomide is an immunomodulatory agent used in the management of multiple myeloma and possesses challenging aqueous solubility characteristics, which may affect its dissolution and oral drug-release behaviour. The study focused on developing a suitable capsule formulation and evaluating its physicochemical and in vitro drug-release characteristics.
Hard gelatin capsules containing Pomalidomide were prepared using suitable pharmaceutical excipients selected to provide satisfactory flow, filling, capsule integrity, and drug-release characteristics. The prepared formulations were evaluated for appearance, weight variation, dimensions, mechanical strength, friability, and in vitro dissolution. The optimized formulation showed a uniform appearance and satisfactory physical characteristics. The capsules exhibited satisfactory mechanical integrity.
The in vitro dissolution study demonstrated a progressive increase in drug release with time. The optimized formulation showed 84.16% drug release at 30 min and 97.10 % at 45 min.
Based on the overall evaluation, the optimized Pomalidomide hard gelatin capsule formulation exhibited satisfactory physical properties and reproducible in vitro drug-release characteristics. The developed formulation may therefore serve as a promising laboratory-scale approach for oral delivery of Pomalidomide. Further studies involving stability, scale-up, and in vivo evaluation are recommended to establish the formulation's long-term performance and suitability.

Keywords: *Pomalidomide; Hard gelatin capsule; Oral drug delivery; Formulation development; Dissolution; Drug release; Pharmaceutical evaluation; Weight variation; Mechanical strength.*

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INTRODUCTION:

Capsules are defined as unit solid dosage form of medicaments available as small containers (shells) made up of gelatin enclosing accurately measured drug substances. The term capsule is derived from the Latin word capsula, meaning a small container. Capsule occupy a significant position in the drug development. They are often believed as the primary oral dosage form because of their manufacturing process compared to other dosage forms. Gelatin has the property of disintegrating when it comes in contact with water, thereby releasing the medicament completely. Instead, of gelatin, denatured gelatin, methyl cellulose and polyvinyl alcohol can also be used to make the capsule shells.There are mainly two types of capsules which are: Hard-shelled capsules, which contain dry, powdered ingredients or miniature pellets made by e.g. processes of extrusion or spheronization. These are made in two halves: a smaller-diameter "body" that is filled and then sealed using a larger-diameter "cap". Both of these classes of capsules are made from aqueous solutions of gelling agents, such as animal protein (mainly gelatin) or plant polysaccharides or their derivatives (such as carrageenans and modified forms of starch and cellulose). Other ingredients can be added to the gelling agent solution including plasticizers such as glycerin or sorbitol to decrease the capsule's hardness.[1]

Capsules are solid dosage forms in which the drug or a mixture of drugs with or without excipients is enclosed in Hard Gelatin Capsule Shells, in soft, soluble shells of gelatin, or in hard or soft shells of any other suitable material, of various shapes and capacities. They usually contain a single dose of active ingredient(s) and are intended for oral administration.

The use of capsules goes back to the early days of pharmacy, and since these early days capsules have evolved significantly to meet the current needs of the patient and pharmaceutical industry. Some of the early developments in capsule technology occurred as pharmacy evolved from dispensing compounded medication to the dispensing of manufactured products; during this change there were numerous advances in gelatin, capsule shell design and high speed manufacturing equipment. Currently the pharmaceutical industry is undergoing a sea change as the blockbuster drugs become harder and harder to find, more of the value of a drug product comes from a dosage form with advanced delivery capabilities that can improve therapeutic outcomes. For example, capsule filling technologies have been developed for the manufacture of multiparticulate delivery systems, multiple dosage form systems such as a tablet in a capsule, combination products and delivery systems with multiphasic release rates. In addition, capsules have always played an important role in the drug development process because hand filling or semiautomatic filling capsule formulations have minimal requirements and can be quickly developed. Given this context, the chapter will discuss the capsule dosage form in the drug development process starting with a discussion of gelatin, the different types of capsules shells, formulation and manufacturing. Also, we will discuss specialty capsules and capsule fills.

Capsules are solid dosage forms in which the drug and such appropriate pharmaceutical adjuncts, such as fillers, antioxidants, flow enhancers, and surfactants are enclosed in a gelatin shell. A "hard" gelatin capsule is composed of gelatin, glycerin, sugar, and water, whereas a "soft" gelatin capsule is composed of only gelatin, glycerin, and water. Capsules vary in size from 000 to 5. As the number increases the capsule size becomes smaller. The sizes provide a convenient container for the amount of drug to be administered and can be of distinctive shapes and colors when produced commercially. Generally, drugs are released from capsules faster than from tablets because the powdered drug has not been compressed and can dissolve at faster rates. The gelatin (a protein) is acted upon rapidly by the enzymes of the GI tract, which permits gastric juices to penetrate and reach the contents to promote dissolution.

Traditionally drugs were obtained through extraction from medicinal plants, but more recently also by organic synthesis. Pharmaceutical drugs may be used for a limited duration, or on a regular basis for chronic disorders. Capsules are a unique dosage form with a long history of use in pharmacy. The original patent was issued in 1834 to a Parisian pharmacist, Joseph Gérard Dublanc, and pharmacy student, François Achille Barnabé Mothès, for the invention and manufacture of gelatin capsules. The term capsule is derived from the Latin word capsula, meaning a small container.

The basic idea of a capsule is to enclose the drug or active pharmaceutical ingredient (API) in an odorless, tasteless, elegant, easy-to-swallow, and easy-to-fill shell. Today there are two main types of capsules: the hard gelatin capsule and the soft gelatin capsule, often called softshells. The hard gelatin capsule can be used for dry fills such as powder, liquids, and semisolids, while the softshell is exclusively used for liquids and semisolids. The typically capsule shell is made of gelatin, but in recent years, there have been a variety of gelatin alternatives introduced to the market. The vast majority of capsule applications are for oral delivery of an API; however, there are specialty applications such as capsules that can be loaded into dry-powdered inhalers, add reagents as part of a diagnostic kit, and occasionally as a suppository

base with glycerin.2 The majority of capsules are filled with a dry powder; however, semisolids, nonaqueous liquids, and other dosage forms such as beads, mini tablets, and even mini capsules can be filled into a capsule shell. These applications will be discussed. In terms of production, capsules are one of the most flexible forms. They can be made one a time in a compounding pharmacy, in small-scale production for clinical studies, and all the way up to commercial production with machines that can make hundreds of thousands of capsules per hour. Given the importance capsules have in the pharmaceutical industry.

From the patient perspective, capsules have many advantages, making them among the most popular dosage forms on the market. Generally speaking, most patients consider capsule shells to be smooth, slippery, and easier to swallow than tablets.[2]

TYPES OF CAPSULES

There exist various capsule types in scholarly articles, they are; the soft gelatin and hard gelatin capsules, Hydroxypropylmethyl cellulose (HPMC) capsules, polyvinyl chloride (PVC) capsules, starch capsules. These can be summarized as the gelatinous and non gelatinous capsules. Gelatin capsules This category of capsules is basically made from gelatin; they can either be soft or hard gelatin capsules. Soft gelatin capsules General aspects Originally developed in the 19th century to mask unpleasant taste and odour of drug substances, soft gelatin capsules are used in many applications, for pharmaceutical, health and nutrition products, cosmetic applications and even recreational products such as paint balls. There exist various capsule types in scholarly articles, they are; the soft gelatin and hard gelatin capsules, Hydroxypropylmethyl cellulose (HPMC) capsules, Polyvinyl alcohol (PVA) capsules, starch capsules. These can be summarized as the gelatinous and non gelatinous capsules.

1] Soft gelatin capsule
2] Hard gelatin capsule

METHODOLOGY:

Characterization of Pomalidomide

Organoleptic properties:

Take a small quantity of sample and spread it on the white paper and examine it visually for color, odour and texture.

Determination of Pomalidomide Melting point

The melting point of Pomalidomide was determined by capillary tube method according to the USP. A sufficient quantity of Pomalidomide powder was introduced into the capillary tube to give a compact column of 4-6 mm in height. The tube was introduced in electrical melting point apparatus and the temperature was raised. The melting point was recorded, which is the temperature at which the last solid particle of Pomalidomide in the tube passed into liquid phase**.**

Determination of Pomalidomide Solubility

Determination of solubility of drug by visual observation. An excess quantity of Pomalidomide was taken separately and adds in 10 ml of different solutions. These solutions were shaken well for few minutes. Then the solubility was observed and observations are shown in the Table.

Analytical method development:

Preparation of 0.1N HCl

Diluted 8.5mL of Concentrated Hydrochloric acid to 1000mL of Purified water and mixed

a) Determination of absorption maxima:

A solution containing the concentration 10 µg/ mL drug was prepared in 0.1N HCL UV spectrum was taken using Double beam UV/VIS spectrophotometer. The solution was scanned in the range of 200 – 400 nm.

b) Preparation calibration curve:

10mg Pomalidomide pure drug was dissolved in 10ml of methanol (stock solution1) from stock solution 1ml of solution was taken and made up with10ml of 0.1N HCL (100µg/ml). From this 1ml was taken and made up with 10 ml of 0.1N HCL (10µg/ml). The above solution was subsequently diluted with 0.1N HCL to obtain series of dilutions Containing 2, 4, 6, 8, 10 µg /ml of per ml of solution. The absorbance of the above dilutions was measured at 253 nm by using UV-Spectrophotometer taking 0.1N HCL as blank. Then a graph was plotted by taking Concentration on X-Axis and Absorbance on Y-Axis which gives a straight-line Linearity of standard curve was assessed from the square of correlation coefficient (R^2) which determined by least-square linear regression analysis.

Drug – Excipient compatibility studies

Fourier Transform Infrared (FTIR) spectroscopy:

The compatibility between the pure drug and excipients was detected by FTIR spectra obtained on Bruker FTIR Germany (Alpha T). The solid powder sample directly place on yellow crystal which was made up of ZnSe. The spectra were recorded over the wave number of 4000 cm^{-1} to 550 cm^{-1}.

Preformulation parameters

The quality of tablet, once formulated by rule, is generally dictated by the quality of physicochemical properties of blends. There are many formulations and process variables involved in mixing and all these can affect the characteristics of blends produced. The various characteristics of blends tested as per Pharmacopoeia.

Angle of repose:

The frictional force in a loose powder can be

measured by the angle of repose. It is defined as, the maximum angle possible between the surface of the pile of the powder and the horizontal plane. If more powder is added to the pile, it slides down the sides of the pile until the mutual friction of the particles producing a surface angle, is in equilibrium with the gravitational force. The fixed funnel method was employed to measure the angle of repose. A funnel was secured with its tip at a given height (h), above a graph paper that is placed on a flat horizontal surface. The blend was carefully pored through the funnel until the apex of the conical pile just touches the tip of the funnel. The radius (r) of the base of the conical pile was measured. The angle of repose was calculated using the following formula:

$\tan \theta = h / r$ $\tan \theta$ = Angle of repose

h = Height of the cone , r = Radius of the cone base

Table: Angle of Repose values (as per USP)

Angle of Repose	Nature of Flow
<25	Excellent
25-30	Good
30-40	Passable
>40	Very poor

Bulk density:

Density is defined as weight per unit volume. Bulk density, is defined as the mass of the powder divided by the bulk volume and is expressed as gm/cm^3. The bulk density of a powder primarily depends on particle size distribution, particle shape and the tendency of particles to adhere together. Bulk density is very important in the size of containers needed for handling, shipping, and storage of raw material and blend. It is also important in size blending equipment. 10 gm powder blend was sieved and introduced into a dry 20 ml cylinder, without compacting. The powder was carefully leveled without compacting and the unsettled apparent volume, Vo, was read.

The bulk density was calculated using the formula:

$$\text{Bulk Density} = M / V_o$$

Where, M = weight of sample

V_o = apparent volume of powder

Tapped density:

After carrying out the procedure as given in the measurement of bulk density the cylinder containing the sample was tapped using a suitable mechanical tapped density tester that provides 100 drops per minute and this was repeated until difference between succeeding measurement is less than 2 % and then tapped volume, V measured, to the nearest graduated unit. The tapped density was calculated, in gm per L, using the formula:

$$\text{Tap} = M / V$$

Where, Tap= Tapped Density

M = Weight of sample

V= Tapped volume of powder

Measures of powder compressibility:

The Compressibility Index (Carr's Index) is a measure of the propensity of a powder to be compressed. It is determined from the bulk and tapped densities. In theory, the less compressible a material the more flowable it is. As such, it is measures of the relative importance of interparticulate interactions. In a free- flowing powder, such interactions are generally less significant, and the bulk and tapped densities will be closer in value.

For poorer flowing materials, there are frequently greater interparticle interactions, and a greater difference between the bulk and tapped densities will be observed. These differences are reflected in the Compressibility Index which is calculated using the following formulas:

$$\text{Carr's Index} = [(\text{tap} - b) / \text{tap}] \times 100$$

Where, b = Bulk Density

Tap = Tapped Density

Table: Carr's index value (as per USP)

Carr's index	Properties
5 – 15	Excellent
12 – 16	Good
18 – 21	Fair to Passable
2 – 35	Poor
33 – 38	Very Poor
>40	Very Very Poor

Purpose of the excipients

Excipient	Function
Pomalidomide	Active pharmaceutical ingredient (API)
MCC PH 102	Diluent/filler; improves flow and compressibility
Lactose monohydrate	Diluent/filler
Crospovidone	Superdisintegrant; promotes capsule content dispersion
Talc	Glidant/anti-adherent
Magnesium stearate	Lubricant

Formulation development of capsules:

Procedure

1. **Weighing of ingredients:** Accurately weighed Pomalidomide and all excipients according to the selected formulation (F1–F6).
2. **Sieving:** Passed the required quantities of Pomalidomide, MCC, lactose monohydrate, and Crospovidone individually through a suitable sieve to obtain a uniform powder.
3. **Geometric dilution:** Transfered the weighed Pomalidomide to a suitable mixing vessel. Add a small portion of MCC/lactose and mix thoroughly. Continue adding the diluent portion-wise using geometric dilution until the API is uniformly distributed throughout the powder blend.
4. **Addition of remaining excipients:** Added the remaining MCC, lactose, and crospovidone to the API-diluent mixture and blend until a homogeneous filling blend is obtained.
5. **Addition of glidant:** Added talc to the blend and mix uniformly.
6. **Addition of lubricant:** Finally, added magnesium stearate and mixed gently for a short period to avoid excessive lubrication.

Hard Gelatin Capsule Filling Procedure

Procedure

1. Selected an appropriate **hard gelatin capsule size** based on the bulk density of the optimized powder blend and the required fill weight.
2. Ensured that the capsule-filling equipment and accessories are clean and suitable for use with the formulation.
3. Loaded the empty hard gelatin capsules into the capsule-filling machine.
4. Separated the **cap and body** of the capsules.
5. Transferred the prepared and evaluated powder blend into the powder hopper/filling chamber.
6. Filled the required quantity of powder into the capsule bodies using the selected filling mechanism.
7. Checked the fill weight periodically during the filling operation and make appropriate adjustments to obtain consistent capsule weights.
8. After filling, replaced the capsule caps onto the bodies and lock the capsules properly.
9. Inspect the filled capsules for:
    - Proper locking
    - Cracks or damaged shells
    - Powder adhering to the outside surface
    - Uniform appearance
    - Appropriate fill weight
10. Collected the filled capsules in a suitable, properly labelled container and store them under the specified conditions until further evaluation.

INGREDIENTS (MG)	FORMULATION CODE					
	F1	F2	F3	F4	F5	F6
Pomalidomide	2	2	2	2	2	2
Microcrystalline cellulose (MCC PH 102)	78	73	68	63	73	68
Lactose monohydrate	12	17	22	27	17	22
Crospovidone	3	3	3	3	5	8
Talc	2	2	2	2	1	1
Magnesium stearate	1	1	1	1	0	0
Total fill weight	100	100	100	100	100	100

Table: Formulation composition for Floating tablets

All the quantities were in mg

Evaluation of Hard Gelatin Capsule

A. Appearance

The prepared hard gelatin capsules were visually inspected for **colour, shape, surface smoothness, presence of cracks, dents, deformation, powder leakage, and uniformity of filling**. The capsules were also examined for any visible defects or discoloration.

B. Weight Variation

Twenty capsules were selected randomly and weighed individually using a calibrated analytical balance. The average weight was calculated, and the percentage deviation of each capsule from the average weight was determined using:

$$\%\ Deviation = \frac{Individual\ weight - Average\ weight}{Average\ weight} \times 100$$

The results were compared with the applicable pharmacopoeial requirements for capsules.

C. Dimensions

The **length and diameter** of the filled capsules were measured individually using a calibrated **vernier caliper**. Measurements were recorded in millimetres, and the mean ± SD was calculated.

D. Hardness/Mechanical Strength

For hard gelatin capsules, **mechanical integrity or shell resistance** may be evaluated using an appropriate capsule-shell/texture testing method. Individual capsules were subjected to controlled mechanical force, and the force required to cause shell deformation or failure was recorded. Results were expressed as mean ± SD.

Note: Conventional tablet hardness testing is generally not directly applicable to hard gelatin capsules. For a thesis, it is better to report **capsule shell integrity/mechanical strength** rather than tablet hardness unless your laboratory has a validated capsule-specific method.

E. Friability

Because friability is primarily a **tablet** test, it is not normally a routine pharmacopoeial quality test for hard gelatin capsules. If required as an experimental study, a specified number of capsules can be weighed and subjected to controlled tumbling in a friabilator for a predetermined number of rotations. After removal of adhering powder and dust, the capsules are reweighed.

$$\%\ Friability = \frac{Initial\ weight - Final\ weight}{Initial\ weight} \times 100$$

Any cracked, broken, or damaged capsules are recorded.

***In Vitro* Dissolution Study**

The *in vitro* dissolution study of the prepared pomalidomide capsules can be performed using a **USP dissolution apparatus**, with the dissolution medium, volume, temperature, agitation speed, sampling time, and analytical method selected during dissolution-method development.

Drug release from Pomalidomide capsules was determined by using dissolution test United States Pharmacopoeia (USP) 24 type II (paddle). The parameters used for performing the dissolution were pH 6.8 medium as the dissolution medium of quantity 900 ml. The whole study is being carried out at a temperature of 37^0 C and at a speed of 75rpm.

General Procedure

1. The dissolution apparatus is assembled and the dissolution medium is transferred into each vessel.
2. The medium is equilibrated to **37 ± 0.5°C**.
3. One capsule is placed in each dissolution vessel.
4. The selected dissolution apparatus and agitation speed are applied.
5. Samples are withdrawn at predetermined time intervals, for example **5, 10, 15, 20, 30 and 45 min**, depending on the developed dissolution profile.
6. An equal volume of fresh dissolution medium maintained at the same temperature is added after each withdrawal to maintain constant volume.
7. The withdrawn samples are filtered appropriately.
8. The amount of pomalidomide released is determined using a suitable **UV-Visible spectrophotometric or HPLC analytical method**.
9. The percentage drug release is calculated at each sampling interval.
10. A plot of **cumulative percentage drug release versus time** is prepared to obtain the dissolution profile.

RESULTS AND DISCUSSION:

Organoleptic properties

Table: Organoleptic properties

S NO.	Properties	Results
1	State	Solid
2	Colour	White
3	Odour	Odorless
4	Melting point	318.5 °C

Solubility studies

Table: Solubility studies of drug in different solvents

S NO.	Solvents	Solubility of Amantadine
1	Acetonitrile	Freely soluble
2	Methanol	Freely soluble
3	0.1N HCl	Freely soluble
4	pH 4.5 Acetate Buffer	Sparingly soluble
5	pH 6.8 Phosphate Buffer	Sparingly soluble

Preparation Of Calibration Curve of Pomalidomide:

The Regression Coefficient was found to be 0.9995 which indicates a linearity with an equation of y = 0.071x - 0.000. Hence beer - Lambert's law was obeyed.

Table: Calibration curve data of Pomalidomide in 0.1N HCl

Concentration (µg/mL)	Absorbance
0	0
2	0.148
4	0.275
6	0.425
8	0.576
10	0.712

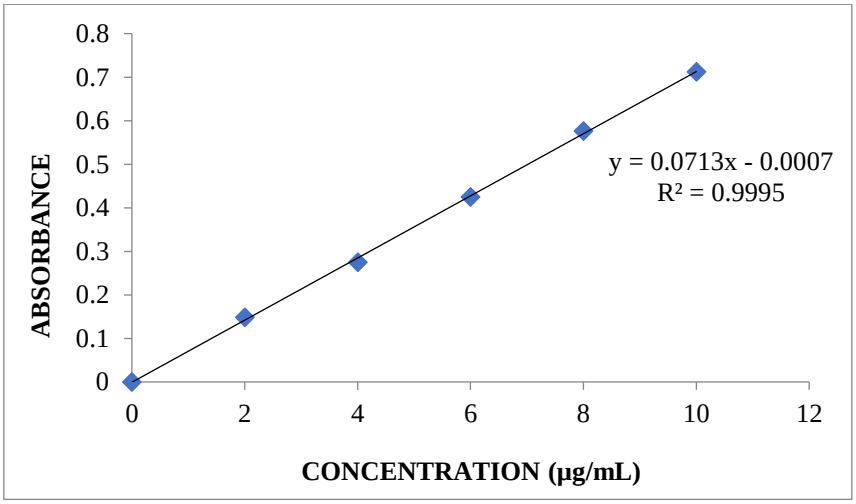


Figure: Calibration curve data of Pomalidomide in 0.1N HCl

EVALUATION OF PRE - FORMULATION PARAMETERS OF POWDER BLEND

Table: Evaluation of pre-formulation parameters of powder blend

Formulation Code	Angle of Repose (°)	Bulk density (gm/mL)	Tapped density (gm/mL)	Carr's index (%)	Hausner's Ratio
F1	25.01	0. 59	0.57	14.03	1.16
F2	26.8	0. 46	0.67	16.41	1.19
F3	27.7	0. 32	0. 54	18.75	1.23
F4	25.33	0.54	0.64	15.62	1.18
F5	25.24	0.52	0.65	18.46	1.22
F6	28.12	0. 46	0. 56	15.15	1.17

- For each formulation blend of drug and excipients were prepared and evaluated for various pre compression parameters described earlier in methodology chapter.
- The bulk density of all formulations was found in the range of (0.32-0.59**)** and tapped density was in range of (0.54-0.69).
- The carr's index and hausner's ratio was calculated from tapped density and bulk density.

Results of Evaluation of Pomalidomide Hard Gelatin Capsules

Physical Evaluation

The prepared Pomalidomide hard gelatin capsules were evaluated for appearance, weight variation, dimensions, mechanical strength, and friability. The capsules were found to be uniform in appearance, free from cracks and dents, and showed satisfactory physical characteristics.

The mechanical strength of the prepared Pomalidomide hard gelatin capsules was evaluated using an appropriate mechanical strength/texture testing method. Six capsules were tested individually, and the force required to cause deformation or rupture of the capsule shell was recorded.

The mechanical strength of the prepared hard gelatin capsules was evaluated using a suitable mechanical testing method. The capsules exhibited a mean mechanical strength of 35.11 N. No cracking, splitting, or deformation of the capsule shells was observed during testing, indicating satisfactory mechanical integrity of the formulated capsules.

Table: Evaluation of Pomalidomide Hard Gelatin Capsules

Formulation codes	Appearance	Weight Variation	Dimensions		Friability (%loss)	Mechanical strength (N)	Observation
			Length (mm)	Diameter (mm)			
F1	Uniform, smooth, intact, no cracks or leakage	101.21	20.1 ± 0.14	6.10 ± 0.01	0.60	35.11	No cracking
F2		100.36	19.5 ± 0.21	7.05 ± 0.11	0.41	32.69	No cracking
F3		99.89	22.3 ± 0.96	6.92 ± 0.20	0.63	29.14	No cracking
F4		102.63	21.9 ± 0.50	7.05 ± 0.19	0.27	34.70	No cracking
F5		101.89	23.2 ± 0.41	6.23 ± 0.28	0.36	29.33	No cracking
F6		100.71	22.4 ± 0.93	7.15 ± 0.92	0.54	30.14	No cracking

***IN VITO* DRUG RELEASE STUDIES OF POMALIDOMIDE HARD GELATIN CAPSULES**

Table: Dissolution data of Pomalidomide

Time (min)	F1	F2	F3	F4	F5	F6
0	0	0	0	0	0	**0**
5	15.75	26.20	30.96	17.99	20.14	19.58
10	32.18	43.71	47.14	26.57	32.61	30.74
15	40.62	56.17	60.27	45.52	41.39	51.93
20	56.10	65.92	73.58	51.78	56.27	63.46
30	65.73	77.80	84.16	65.44	67.98	80.33
45	73.14	89.42	97.10	76.12	85.71	96.92

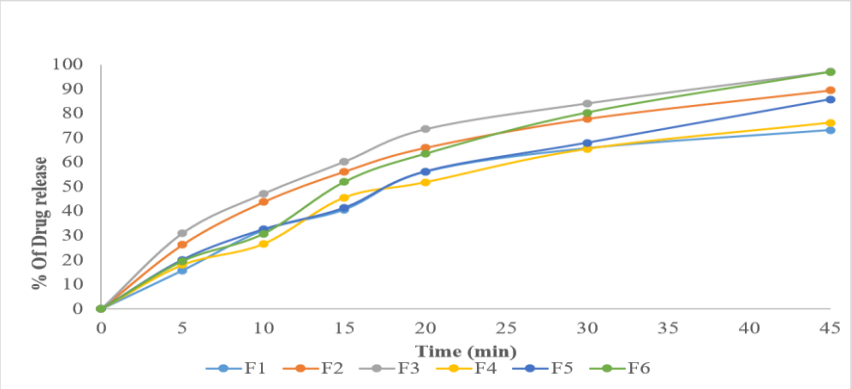


Fig: Dissolution profile of formulations F1 – F6

The optimized Pomalidomide hard gelatin capsule formulation was subjected to an *in vitro* dissolution study to evaluate the drug-release behavior. The formulation showed a gradual and consistent increase in drug release with increasing dissolution time. The cumulative drug release was **30.96%** at **5 min**, which increased to **60.27% at 15 min** and **84.16% at 30 min** and a maximum cumulative drug release of **97.10%** was observed at 45 min.

Based on the above data F3 Formulation considered for optimized formulation.

The rapid initial release may be attributed to the disintegration of the hard gelatin capsule shell and subsequent wetting and dispersion of the formulation powder in the dissolution medium. The progressive drug release observed thereafter may be associated with dissolution of Pomalidomide from the formulation matrix and improved wetting of the drug particles by the dissolution medium.

FTIR RESULTS:

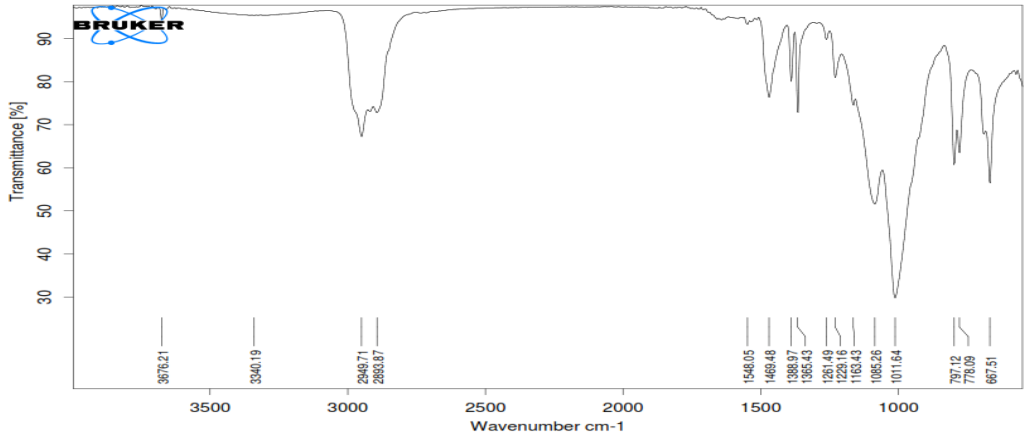


Fig: FTIR of Pomalidomide Pure drug

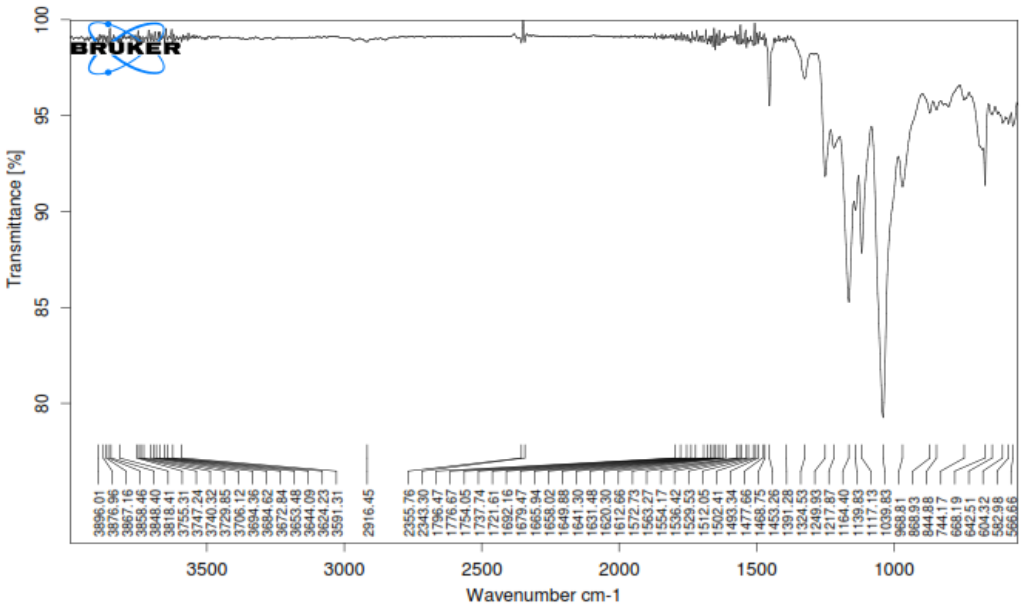


Fig: FTIR of Pomalidomide optimized Formulation

Pomalidomide was mixed with various proportions of excipients showed no colour change, providing no drug-excipient interactions.

Compatibility between Pomalidomide and the selected excipients was investigated using Fourier Transform Infrared Spectroscopy (FTIR).

The FTIR spectra of the pure drug, individual excipients, and physical mixtures of the drug with selected excipients were recorded over an appropriate wavelength range. The characteristic peaks of Pomalidomide were compared before and after mixing with the excipients.

The absence of significant changes, disappearance of characteristic peaks, or appearance of new peaks was considered indicative of the absence of major chemical interaction between the drug and excipients.

CONCLUSION:

The present study was undertaken with the objective of formulating and evaluating hard gelatin capsules of Pomalidomide. The prepared formulations were evaluated for various pharmaceutical parameters, including appearance, weight variation, dimensions, mechanical strength, friability, and *in vitro* drug-release characteristics.

The formulated capsules exhibited acceptable physical properties, satisfactory weight uniformity, adequate mechanical integrity, and good capsule-shell stability. The optimized formulation demonstrated a consistent and reproducible drug-release profile, with approximately 97.10% drug release at 45 min under the selected dissolution conditions. The low variation in dissolution results indicated good formulation uniformity and reproducibility.

Based on the overall evaluation, the optimized Pomalidomide hard gelatin capsule formulation showed satisfactory physicochemical characteristics and *in vitro* drug-release performance. Therefore, the developed formulation can be considered a promising laboratory-scale approach for the oral delivery of Pomalidomide. Further studies, including stability studies, scale-up studies, and in vivo evaluation, would be required to establish its long-term stability and performance.

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