Formulate And Evaluate Immediate Release Tablet of Antihypertensive Drug

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***Abstract*—Conventional pills of lisinopril were developed to treat hypertension. The medication was determined to be steady. Additionally, it was verified by FTIR analysis that there is no interaction between the medicine and the excipients due to incompatibility findings in various ratios. The hardness, weight fluctuation, thickness, friability, disintegration, dissolution, and other characteristics of the final tablets were assessed. All of the Lisinopril formulations made using the wet granulation process were subjected to in vitro drug release profiles using a modified dissolution equipment. The temperature was kept at 37±0.5°C. Figure 17 displays the % cumulative medication release graphs. The medication release was determined to be lower because the F1 trial batch needed more time to dissolve and disintegrate.**

After adding 10 mg of aerosil and 15 mg of sodium starch glycolate to the F3 batch, there was a noticeable increase in drug release.

F3 demonstrated a 98.54% drug release in 30 minutes across all of these formulations.

It indicates that this formulation produced the highest level of medication release.

With 98.54% drug release, the formulation F3 Batch was deemed optimal because it met all pharmaceutical standards and seemed to provide better therapeutic effects.

Stability Studies: To ascertain the formulation's physical stability, stability studies were conducted for the improved formulation (F3).

The findings demonstrated that the parameters assessed during the research period under expedited settings did not significantly alter.

Table No 01: Parameters studies on F4 formulation before and after stability study

Parameter	0 Days	30 Days	60 Days
Hardness (kg/cm2)	3.8+0.2	3.7+0.2	3.7+0.2
Thickness (mm)	3.5+0.2	3.5+0.2	3.5+0.2
Weight Variation (mg)	300.5+10	299.9+9	299.9+8
Friability (%)	0.35+0.2	0.36+0.2	0.35+0.2
Drug content (%)	98.54+0.19	98.68+0.19	98.45+0.19
Drug Release (%)	98+0.09	97+0.18	97+0.23

I. INTRODUCTION [

An oral dose form is a medicinal preparation intended for oral consumption, either whole or after chewingThe body receives medication in these forms, which include tablets, capsules, suspensions, solutions, and syrups. Oral dosage forms are a popular and useful method of administering medication because they are easy to use, generally safe, and accessible in a variety of dosages and formulations to address the needs of diverse patient populations. They are also an effective way to deliver medication to the body since the digestive system can quickly absorb drugs from the gastrointestinal tract and distribute them throughout the body. Oral dose forms help regulate the amount of medication that reaches the bloodstream over time can be designed to release

drugs into the body at different speeds. To ensure a steady and consistent flow of medication into the body, some pills, for example, are designed to release medication over several hours. This can be highly beneficial for drugs that require a constant and progressive release in order to maintain their therapeutic effect over time.

All things considered, oral dosage forms play a significant role in modern medicine and are used to treat a wide range of ailments, from simple ones like colds and headaches to more complex ones like cancer and heart disease. They enable patients to obtain the necessary medication in a quick, safe, and effective manner, making them a crucial part of modern healthcare.[1]

Because of its simplicity of swallowing, pain, avoidance, adaptability, and most importantly patient compliance, oral administration is the most widely used method for systemic effects. For the administration of high molecular weight proteins and peptides that are poorly soluble, the development of improved oral protein delivery technology by quick release tablets that may release the medications at an enhanced pace is particularly promising. The oral route is still the best way to provide therapeutic agents since patient compliance is high due to the inexpensive cost of therapy, manufacturing, and administration. [1-2]

Dosage Forms for Tablets

Drug powder or granules are compressed with excipients such as fillers, binders, disintegrants, lubricants, and coatings to create tablets, which are solid dosage forms.

A.Depending on the Manufacturing Process • Compressed tablets:

These are created by using a tablet press to compress the medication and excipients.

• Molded tablets:

These are made by shaping a damp substance into the shape of a tablet.

• Chewable tablets:

These are typically flavored and chewed before being swallowed.

• Effervescent tablets:

They dissolve in water and emit fizz, or CO2.

B. Depending on the Administration Route • Oral tablets:

These are ingested and absorbed in the digestive system.

• Sublingual tablets:

For quick absorption, dissolve them beneath the tongue.

• Buccal tablets:

These are positioned between the gums and the cheek.

• Vaginal tablets:

These are used locally in the vagina. Rectal pills are administered locally or systemically by inserting them into the rectum.

C. Considering the Release Pattern

• Immediaterelease tablet: These tablets release the medication rapidly after consumption.

• Extendedrelease tablets: The medication is released gradually.

• Delayedrelease tablets: They release the medication after a predetermined amount of time.

• Controlledrelease tablets: Keep medication levels steady.

D. Considering Dosage Strength • Tablets with low dosages • Tablets with a high dosage

• Fixed dose combo tablets that contain several medications • Pediatric pills (children's dosages are smaller)

E. Considering Composition and Appearance Tablets with a film coating • Tablets with scores (divided) • Tablets with different colors

• Tablets with unique shapes (oval,oblong, triangular)

Tablets with immediate release (IR Tablets) Oral tablets known as immediate release tablets are made to quickly dissolve and release the medication after being taken, resulting in a rapid commencement of action.

Characteristics

• Quick breakdown in the GI system • Quick absorption of drugs • Often used to treat pain, fever, allergies, high blood pressure, etc.

Immediate Release Tablet Formulation A. The active component• Offers the therapeutic benefit.

B. Excipients 1. Diluents: Boost bulk (MCC, lactose, and mannitol). 2. Binders: Provide mechanical strength (methylcellulose, povidone). 3. Superdisintegrants, such as croscarmellose sodium and crospovidone, aid in the rapid breakdown of tablets. 4. Lubricants: Use magnesium stearate to lessen sticking during compression. 5. Glidants:

Enhance the flow of powder (colloidal silicon dioxide). 6. Coating agents (HPMC, PEG): Boost stability and attractiveness

SuperDisintegrants Superdisintegrants speed up the breakdown and disintegration of tablets.
Mechanism
• Swell after absorbing water • Make the tablet's pores and channels • Tablet disintegration due to an increase in internal pressure
1. Swelling or non-swelling Crospovidone with sodium starch glycolate Sodium croscarmellose
2. Complexing/surface-active o Sodium lauryl sulfate o Ion-exchange resins
Techniques for Making Immediate Release
Tablets
1. Molding tablets
2. Direct compression
3. Granulation that is wet
4. Extrusion of mass 5. The process of solid dispersion
Considerations for Formulation
Key elements influencing tablet performance include:
• Physicochemical characteristics of drugs • The choice of excipients
• Production process • Tablet design (weight, size, and shape)
• Coating
• Requirements for regulations
Ideal properties of Drug for Immediate release Tablets
• Excellent solubility
• Quick dissolution
• Consistent
• Not hygroscopic
• Minimal dosage
• Not irritating
• A broad therapeutic index
• A brief half-life
Elevated bioavailability
Benefits of Tablets with Immediate Release
• Quick start to activity
• Easy dosage
• Simple to swallow
Improved adherence to treatment
Economical Drawbacks
• A brief period of action • Potential adverse consequences • Unsuitable for medications requiring prolonged
release
• Interactions between drugs
• Dose dumping risk
High blood pressure, or hypertension

Chronic hypertension is defined by consistently elevated blood pressure, which puts stress on the heart and blood vessels.

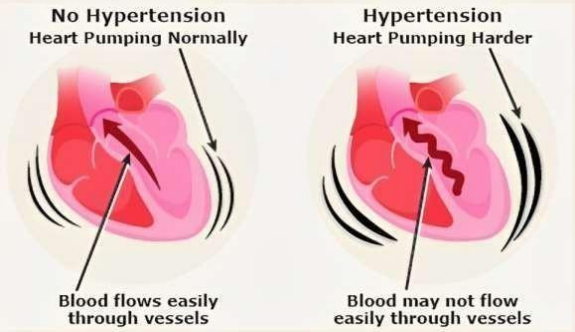

Figure 1: Heart

Symptoms
Frequently asymptomatic, but could include: • A headache
• Weariness
• Lightheadedness
• Pain in the chest Palpitations
• Lack of breath
Causes
• Being overweight
• Smoking
• Stress
• A diet heavy in salt
• Insufficient physical activity
• Genetic variables
Pathogenesis High arterial pressure brought on by increased vascular resistance can result in:

- Heart conditions
- Damage to the kidneys
- Damage to the eyes
- A stroke

Antihypertensive Drug Classification
1. Diuretics: Boost the production of urine Examples include spirolactone, furosemide, and hydrochlorothiazide.
2. Beta-blockers: Lower heart rate Examples include metoprolol, propranolol, and
atenolol. 3. Calcium Channel Blockers: They cause blood
arteries to relax Amlodipine, Nifedipine, and Verapamil are a few

examples. 4. ACE Inhibitors: Prevent the production of
angiotensin II Lisinopril, Enalapril, and Captopril are a few
examples.
5. Angiotensin II receptors are blocked by ARBs. Examples are Candesartan, Valsartan, and Losartan.
6. Direct Inhibitors of Renin For instance, Aliskiren
7. Alpha-blockers For instance, terazosin, prazosin, and doxazosin 8. Vasodilators Examples include minoxidil and hydralazine.

II. MATERIALS AND METHODS

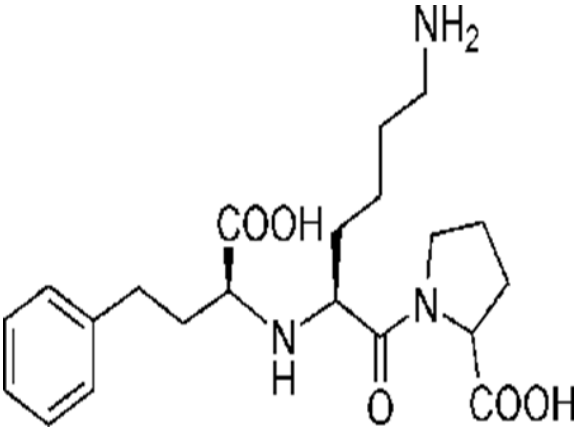

Fig. no.2 Structure of Lisinopril

Chemical Name: (S)-1-[N2-(1-carboxy-3-phenylpropyl)-L-lysyl]-L-proline.
Molecular Formula: $C_{21}H_{31}N_3O_5$.
Molecular Weight: 441.53 g/mol.
Description: It is a white to off-white crystalline powder.
Melting Point Range: 154-158°C.
Solubility: Lisinopril is freely soluble in water, but only slightly soluble in ethanol.
Partition Coefficient: Lisinopril is moderately hydrophilic, with a Log P of roughly 0.8.
Storage and Stability:
When kept at room temperature and shielded from light and moisture, it stays stable for roughly two years. Lisinopril's indications include the following: • High blood pressure, or hypertension • Heart failure that is congestive • A heart attack, or acute myocardial infarction Additionally, it increases heart failure patients'
chances of survival following a heart attack.

Pharmacokinetic Characteristics

1. Absorption
• After oral administration, well absorbed • It took almost seven hours to reach the peak plasma concentration. • Food has little effect on absorption.

2. Linearity
• Within the therapeutic dose range, it exhibits linear pharmacokinetics.

3. Distribution
• Low distribution volume (~0.5 L/kg) • Mostly found in extracellular fluid • Does not build up in tissue

4. Biotransformation
• The liver does not considerably metabolize • Hydrolyzes to produce lisinoprilat, an active metabolite.

5. Removal:
• Mostly removed by the kidneys • About 75% was eliminated in urine unaltered. • Half-life: approximately 12 hours

6. Binding of Proteins:
• Low binding of plasma proteins

7. Toxicity:
Usually easily tolerated, but may result in: Hypotension, Excessive potassium ,Renal failure in people who are at risk.

8.Dosage: • 10 mg once daily is the starting dose for hypertension.
• 80 mg once daily is the maximum dosage.

9. Administration Route: Taken orally (as tablets).

10.Contraindications: Patients with the following conditions shouldn't use lisinopril:
• Angioedema's past
• ACE inhibitor hypersensitivity • Renal artery stenosis on both sides
11.Adverse Reactions: • Common:stomach distress, dry cough, and dizziness • Serious (less frequent): renal failure, hyperkalemia, and hypotension Formulations that are accessible in India: There are 2.5

mg lisinopril tablets available.5 mg, 10 mg, and 20 mg strengths.

Excipients profile

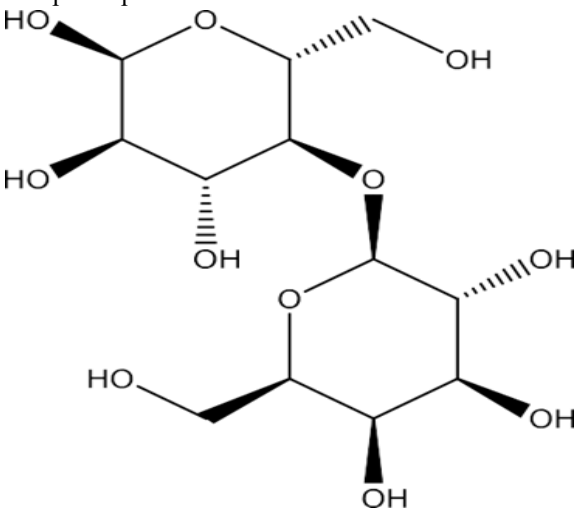

Figure No. 3. Lactose

Chemical Name: Lactose
Molecular Formula: C12H22O11
Molecular Weight: 342.3 g/mol
Description: Lactose is a white, odorless, crystalline powder with a slightly sweet taste.

1. Melting Point Range: Lactose has a melting point range of 203-205°C.
Solubility: Insoluble in organic solvents, highly soluble in hot water, and sparingly soluble in cold water (~18%).
Storage: Keep out of direct sunlight and dampness in a cool, dry location.
Use/Indication: Used as a sweetener in food and as a common excipient (diluent/filler) in tablets and capsules.
Side effects: May result in symptoms of lactose intolerance, such as diarrhea, bloating, and abdominal pain.

2. Microcrystalline cellulose
• Formula: $(C_6H_{10}O_6)_n$ • Description: A white, odorless powder composed of particles of cellulose. • Solubility: It absorbs water and swells despite being insoluble in it. • Storage: Stable for years, store in a dry location. • Use: Pharmaceutical excipient, primarily for tablet filler and binder.

3. Dibasic calcium phosphate
$CaHPO_4$ is the formula. • 136.06 g/mol is the molecular weight. • Solubility: Not soluble in organic solvents or water. • Storage: Keep dry and cool, away from moisture.
• Use: Excipient for tablets; additionally used as a calcium and phosphorus supplement.

4. Sodium starch glycolate
Crosslinked sodium carboxymethyl starch is the chemical name.
• Description: Odorless, white powder. • Solubility: Swells quickly but is insoluble in water. • Storage: Keep in a dry, cold environment. • Use: Superdisintegrant to enhance pill breakdown and disintegration.

5. Polyethylene glycol
• Formula: $H(OCH_2CH_2)_nOH$ • Description: A liquid or semi-solid polymer with no color and no smell. • Solubility: Extremely soluble in a variety of organic solvents and water. • Storage: Keep out of direct sunlight in a cool, dry location. • Uses: Drug delivery medium, lubricant, emulsifier, solubilizer, and laxative.

6. Silicon dioxide aerosil
The formula is SiO_2. • Description: A white powder with a large surface area and tiny particles. • Solubility: Not soluble in organic solvents or water. • Storage: Keep it dry and away from moisture.
• Use in pharmaceutical formulations as a thickening, gliding, and anti-caking ingredient. • Safety: Generally safe, though breathing in dust might irritate the respiratory system.

7. Phosphate Dicalcium
$CaHPO_4$ is the formula. • Solubility: Almost insoluble in organic solvents and water. • Storage: A cool, dry location away from light and moisture. • Use: A source of calcium and phosphorus in supplements and animal feed, as well as an excipient in tablets.

Lisinopril Tablet Preformulation studies

1. Research on Preformulation
Preformulation investigations examine the drug's chemical and physical characteristics both on its own and in combination with excipients. Objectives: •

Ascertain the drug's physicochemical characteristics. • When developing a dosage form, make sure the excipients are compatible.

2. Lisinopril Characterization
Organoleptic Characteristics • Examining the drug sample's look, color, and smell.

Description • Documenting the product's name, manufacturer, lot number, texture, and look.

Point of Melting • Ascertained using a melting point device and
capillary tube. • The typical melting point is between 148 and 150°C.
Test for Solubility • To determine if a drug is soluble or insoluble, combine it with a solvent (such as ethanol).

Determining pH • A 0.1 M solution was made in distilled water. • The measured pH was compared to the pH range of 3–4.3.

Micromeritic Characteristics Assessment of powder flow properties: • Angle of Repose Bulk Density Tapped Density Carr's Index The Hausner Ratio
These parameters determine powder flowability and compressibility.

3. Analysis of Spectroscopy
1. UV Spectroscopy
• A stock solution (100 µg/ml) was made. • Scanned in the 200–400 nm range. • 218 nm is the maximum absorption (λmax)• Calibration curve prepared (2–12 µg/ml). • Good linearity is shown by the regression result of 0.9997.

2. Infrared Spectroscopy
• FTIR is employed between 400 and
4000 cm^{-1}.
• Used to find drug excipient incompatibility and identify functional groupings.

3. Studies of Compatibility
• IR spectroscopy was used to investigate drug and polymer physical mixes.
• Guarantees that no reaction takes place that would compromise stability or shelf life.__

Preparation of Tablet:

4. Formulation of Lisinopril tablet:

Ingredient In Mg	F1	F2	F3	F4	F5	F6
Lisinopril (API)	5	5	5	5	5	5
Lactose	25	35	45	20	15	10
Microcrystalline cellulose	20	15	10	30	10	20
Sodium starch glycolate	25	20	15	10	12	18
Polyethylene glycol	6	10	5	12	10	5
Aerosil	10	15	10	5	15	10
Dibasiccalcium phosphate	10	15	20	10	15	20
Starch	Q. S.	Q. S.	Q. S.	Q. S.	Q. S.	Q. S.

Table no.2 : Formulation of Lisinopril

5. Tablet Evaluation
A. Bulk density and tapped density:
Directly compressible blend was poured gently through a glass funnel into a graduated cylinder of bulk density apparatus. Then Bulk density and tapped density were calculated.

$$\text{Bulk density} = \frac{\text{Weight of sample in gram}}{\text{Final volume of sample contained in cylinder}}$$

$$\text{Tapped density} = \frac{\text{Weight of sample in gram}}{\text{Final volume after tapping in cylinder}}$$

B. Carr's compressibility index:

Compressibility index is an important measure that can be obtained from the bulk and tapped densities. According to the theory, the less compressible material is more flowable. A material having values less than 20 to 30% is defined as the free-flowing material, based on the apparent bulk density and tapped density, the percentage compressibility of the bulk drug was determined by using the following formula. It is expressed in percentage and is expressed by

$$I = (Dt - Db / Dt) \times 100$$

Where:

Dt - is the tapped density of the powder Db- is the bulk density of the powder.

The compressibility index and Hausner ratio are measures of the products ability to settle, and permit an assessment of the relative importance of inter particulate interactions. In a free-flowing powder these interactions are less significant and the bulk and tapped densities will be closer in value. For poorly flowing materials, there are greater Inter particulate interactions and a greater difference between the bulk and tapped densities will be observed. The differences are reflected in the compressibility index and Hausner ratio Compressibility index :the circular base on the paper. Record diameter & radius &. The angle of repose was determined by

Tan (θ) = h / r Angle of repose (θ) = tan -1 (h / r)

Where,

h= height of the heap

r= radius of the heap

Flow property	Angle of repose (degrees)
Excellent	25-30
Good	31-35
Fair	36-40
Passable	41-45
Poor	46-55
Very poor	56-65
Very very poor	>66

Table 3. Relationship between angle of repose (θ) and Flowability

1. Variation in Weight

• Twenty pills, each weighed separately. • Pharmacopoeial limits must be met.

2. Hardness

• Monsanto hardness tester (kg/cm2) was used for measurement.

3. Thickness

• Vernier calipers were used for measurement.

4. Content of Drugs

• Tablets were crushed and measured at 298 nm using a UV spectrophotometer.

$$\text{Drug content} = \frac{\text{Conc.}^{n} \times \text{vol.} \times DF}{1000}$$

Dissolution Study in Vitro • Performed at 37 ± 0.2°C in a 900 ml dissolution medium. • 100 rpm is the paddle speed. • Samples collected after five, ten, fifteen, and thirty minutes. • UV spectrophotometry is used to assess drug release. • Data fitted to first- and zero-order kinetics.

Research on Stability Stability guarantees that the medication retains its medicinal, chemical, and physical qualities while being stored.

Conditions of Storage Study Type, Conditions, and Length

Long-term: 60% RH ±5% and 25°C ±2°CA full year

Intermediate: 30°C ±2°C/65% RH ±5% RH 6 months

Accelerated: 40°C ±2°C/75% RH ±5% RH 6 months

Formulations are assessed based on their appearance, thickness, moisture content, drug release, and drug content.

III. RESULT AND DISCUSSION

1. Characterization of Lisinopril:

1.1. Organoleptic characterization and Melting point determination

The physicochemical characteristics of Lisinopril are described in Table 12.

Table 4. Physicochemical Characteristics of Lisinopril

SR. NO	TEST	OBSERVATION
1.	Appearance	White crystalline powder
2.	Color	White to off-white
3.	Odor	Odorless
4.	Taste	Tasteless
5.	Melting point	148-150°C
6.	pH	Aqueous solutions are acidic with a pH of approximately 3.5

The organoleptic character and melting point was found as per the standard drug so drug used in the formulation was found to be pure according to I.P. specification.

1.2. Solubility analysis:

Table 5: Solubility profile of Lisinopril

SR. NO.	SOLVENT	SOLUBILITY
1.	Water	Freely soluble, 60 mg/mL at 25°C
2.	Methanol	Sparingly soluble, 2.5 mg/mL at 25°C
3.	Ethanol	Practically insoluble, <0.5 mg/mL at 25°C
4.	Acetone	Practically insoluble, <0.5 mg/mL at 25°C
5.	Ethyl acetate	Practically insoluble, <0.5 mg/mL at 25°C
6.	Chloroform	Practically insoluble, <0.5 mg/mL at 25°C
7.	Diethyl ether	Practically insoluble, <0.5 mg/mL at 25°C
8.	Hexane	Practically insoluble, <0.5 mg/mL at 25°C
9.	Isopropyl Alcohol	Sparingly soluble, 2.5 mg/mL at 25°C
10.	Propylene glycol	Sparingly soluble, 1.3 mg/mL at 25°C
11.	Glycerin	Sparingly soluble, 1.0 mg/mL at 25°C

1.3. Micromeritic characterization of drug:

The micromeritic characterizations of drug were carried out and the following observations were made.

Table 6: Micromeritic characterization of Lisinopril

SR. NO.	Property	Value
1.	Bulk density	0.4-0.6 g/mL
2.	Tapped density	0.5-0.7 g/mL
3.	Hausner's ratio	1.25-1.40
4.	Carr's index	10-20%
5.	Angle of repose	28-32°
6.	Particle size distribution (D50)	20-50 µm
7.	Surface area (BET)	~1-2 m^2/g
8.	Porosity	~0.3-0.4 mL/g

On the basis of micromeritic properties it was confirmed that the drug Lisinopril possessed sufficient Flowability to be used for compression.

1.3 Standard calibration curve of Lisinopril.

Table 7: Standard calibration curve of Lisinopril.

SR. NO.	CONCENTRATION (ug/ml)	ABSORBANCE (at 218 nm)
1.	2	0.0591
2.	4	0.1245
3.	6	0.1891
4.	8	0.2987
5.	10	0.4026
6.	12	0.5112
7.	14	0.6512
8.	16	0.7451

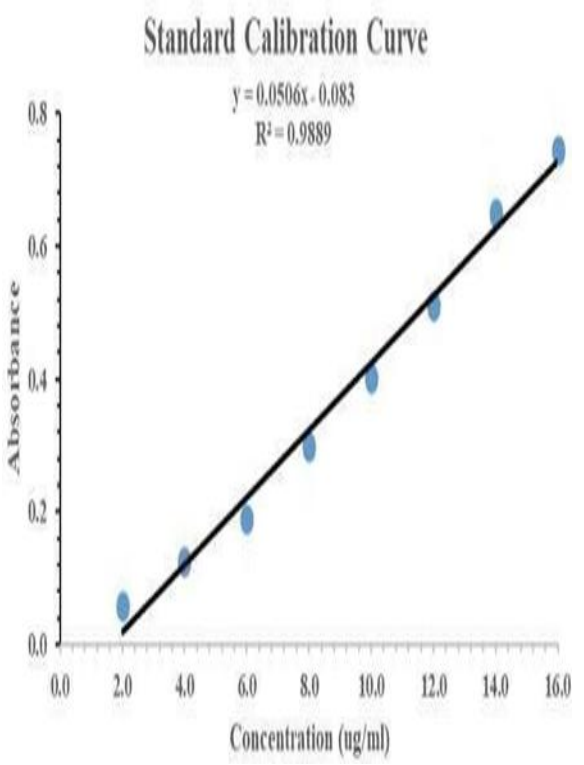

Figure 3. Calibration curve of Lisinopril in Water.

1.4. Determination of λ max:.

The UV spectrum of Lisinopril in water showed maximum absorption at 218nm. Hence drug used in the formulation was found to be pure according to I.P. specification. The UV spectrum of the Lisinopril in methanol is given in Figure:

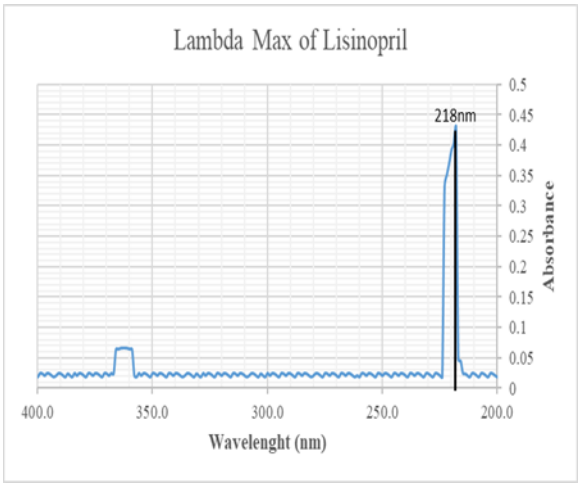

Figure No. 4. Lambda Max of Lisinopril

1.5. FTIR Analysis

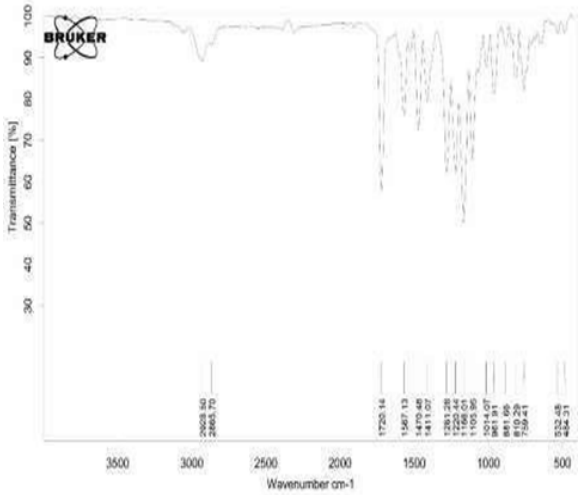

Figure No. 5. FTIR of Lisinopril

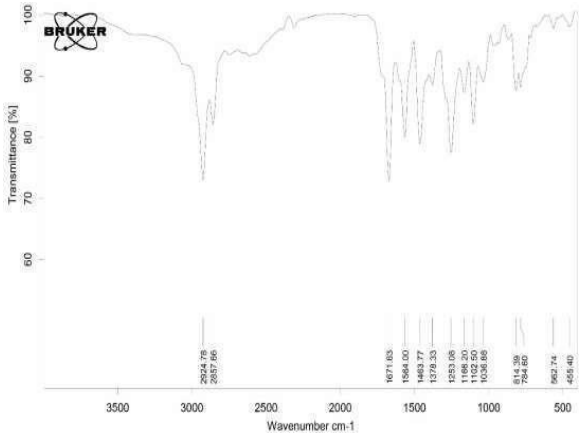

Figure No. 6. FTIR of Lisinopril with Sodium Starch Glycolate

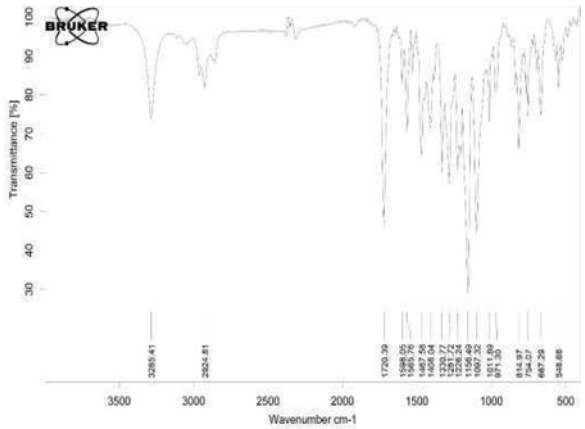

Figure No. 7. FTIR of Prepared Tablet

1.6.Characterization of prepared Lisinopril Tablet:

FORMULATION	APPEARANCE
F1-F6	Clear white, easily removed by die

Table 8.: Appearance of Lisinopril Tablet.

Evaluation of Lisinopril Tablet:

SR. NO	PARAMETER	F1	F2	F3	F4	F5	F6
1.	Bulk density (g/cm³)	0.49	0.53	0.57	0.48	0.52	0.56
2.	Tapped density (g/cm³)	0.60	0.66	0.70	0.59	0.64	0.69
3.	Hausner's ratio	1.2	1.2	1.2	1.2	1.2	1.2
4.	Carr's index (%)	12	15	18	10	13	16
5.	Angle of repose (°)	27	28	30	25	27	29
6.	Flow rate (g/s)	2.5	2.3	2.1	2.4	2.2	2.0
7.	Compressibility index (%)	12	14	16	11	13	15
8.	Moisture content (%)	0.8	0.7	0.9	1.0	0.8	0.6
9.	Particle size distribution (%)	90% passing 100 mesh	95% passing 100 mesh	90% passing 80 mesh	85% passing 100 mesh	90% passing 90 mesh	95% passing 80 mesh

Table 9. Precompression Evaluation of The Powder Blend

1.6.1. Bulk density

It has been stated that the bulk density values less than 1.2 g/cm2 indicate good packing and values greater than 1.5 g/cm2 indicate poor packing. The loose bulk density and tapped bulk density values for all the formulation varied in range of 0.312±0.12 g/cm3 to 0.321±0.27 g/cm3 respectively. The values obtained lies within the acceptable range.

1.6.2. Compressibility index

The percent compressibility of was determined by Carr's compressibility index, the results shown in Table 17. The percent compressibility for all formulation lies within the range of 5.12±0.29% to

10.33±0.51% indicates acceptable flow property.

1.6.3. Hausner ratio:

Hausner ratio was found to be in a range of 1.05±0.21 to1.11±0.37 which shows acceptable flow property and good packing ability.

1.6.4. Angle of repose:

The results of angle of repose of all the formulations were found to be in range of 250 16'±0.12 to 280 38'±0.15 indicating good flow property and this was further supported by lower compressibility index values. Thus, it can be concluded that the granules for all the batches possessed good flow characteristics.

1.7. Evaluation of Prepared tablet

Prepared tablet of all formulations (F1 to F6) were evaluated for different parameters such as thickness, hardness, weight variation, drug content and friability and results are shown in table no.13

Table 10: Standard physical tests for Table

Parameter	F1	F2	F3	F4	F5	F6
Hardness (kg/cm2)	3.2±0.42	3.6±0.3	3.8±0.2	3.2±0.48	3.7±0.56	4.1±0.34
Thickness (mm)	3.9±0.2	3.9±0.2	3.5±0.2	3.6±0.2	3.6±0.2	3.8±0.2
Weight Variation (mg)	130.0±10	129.7±10	120.5±10	128.0±10	125.0±10	123.1±10
Friability (%)	0.45±0.18	0.81±0.2	0.35±0.2	0.65±0.37	0.12±0.67	0.38±0.62
Drug content (%)	96.18±0.12	93.18±0.54	98.54±0.19	92.18±0.34	94.18±0.69	98.21±0.37
Drug Release (%)	52±0.09	58±0.09	98±0.09	88±0.09	60±0.09	54±0.09

1.7.1. Hardness

Tablet hardness was determined by using Monsanto hardness tester. Hardness values of the formulation ranged from 3.2-4.1 kg/cm2, which indicate good strength of tablet

1.7.2. Friability Tablet

friability was determined by Roche friabilator and weight loss was calculated and represented in the terms of percent friability. Friability values of all the formulation were less than 1%, indicating good strength of tablet.

1.7.3. Weight variation

In weight variation test, the weight variation values of prepared Tablet between 299- 309 mg. Pharmacopeial limit for percent of deviation for Tablet weighing is not more than 10 %. The average percent deviation of all Tablet was found to be within the limit and hence all formulation passes the weight variation test.

All the values are representing as Mean ± S. D. (standard deviation) (n=3)

1.7.4. Thickness

Examination of Tablet from each batch showed flat circular shape with no cracks having white color. The thickness of Tablet was determined using Vernier caliper. The thickness of Tablet ranged from 3.6-3.9 mm. All formulations showed uniform thickness.

1.7.5. Content uniformity

The drug content was found to be uniform among all formulation and ranged from 92.18 -98.54%.

1.7.6. In-vitro drug release studies:

The study was carried out in modified dissolution apparatus with 900 ml of N HCl as dissolution medium is taken in beaker and maintained at 37± 0.5 0C. The prepared tablets are placed in apparatus, at different time intervals 30 min. The samples were filtered through filter paper and analyzed for drug concentration after appropriate dilution at specific wavelength using UV-Visible spectrophotometer.

Table 11: In-vitro drug dissolution data of F1 to F3 formulation

FORMULATION	CUMULATIVE % DRUG RELEASE	TIME	CUMULATIVE % DRUG RELEASE	TIME
F1	48	15	81	30
F2	55	15	85	30
F3	69	15	98	30

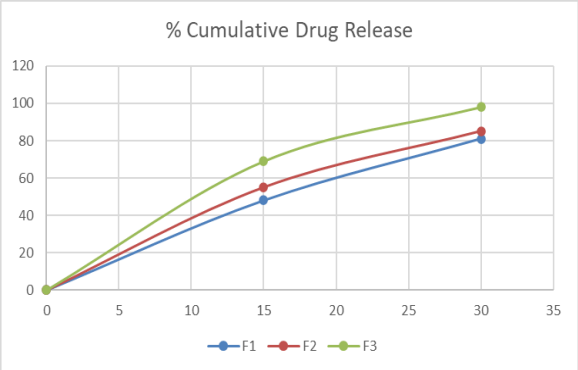

Figure 8 In-vitro dissolution profile of F1 to F3 formulation

Table 12: In-vitro drug dissolution data of F4 to F6 formulation

Formulation	Cumulative % Drug Release	Time	Cumulative % Drug Release	Time
F4	58	15	88	30
F5	45	15	72	30
F6	48	15	81	30

All the values are representing as Mean ± S. D. (standard deviation) (n=3)

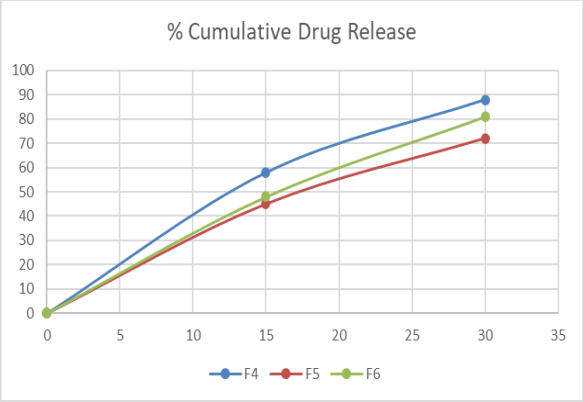

Figure 9.: In-vitro dissolution profile of F4 to F6 formulation

All the formulation prepared were subjected to in-vitro release study. In vitro drug release profiles of all the formulations of Lisinopril prepared by wet granulation method were performed by modified dissolution apparatus. The temperature was maintained at 37± 0.5 ^{0}C. The % cumulative drug release graphs shown in figure (12-13).

When the Sodium Starch Glycolate was added then increase in the drug release. But the color are buff and blackish. Then the Aerosil was added then result are the clear white colour tablet and drug release increases. In all these formulations F3 showed the drug release of 98.06 % within 30 min. it means that maximum drug release was observed using this formulation, so it is said to be optimized formulation of series is (F3) which is prepared by wet granulation method.

From the results (table 19-20 & figure 12-13)

Table 13: Parameters studied on F3 formulation before and after stability study

PARAMETER	BEFORE STABILITY TESTING	AFTER STABILITY TESTING
	F3	F3
Thickness	3.5+0.2	3.47+0.2
Hardness	3.8+0.2	3.8+0.2
Dug Content	98.54+0.19	98.48+0.21

Stability Study:

Stability studies for the optimized formulation (F3) was carried out in order to determine the physical stability of the formulation. The results were shown in there was no significant change in the parameters which are evaluated during the study period in the accelerated conditions.

Table 14: Parameters studies on F3 formulation before and after stability study

Parameter	0 Days	30 Days	60 Days
Hardness	3.8+0.2	3.7+0.2	3.7+0.2

(kg/cm2)			
Thickness (mm)	3.5+0.2	3.5+0.2	3.5+0.2
Weight Variation (mg)	120.5+10	119.9+9	119.9+8
Friability (%)	0.35+0.2	0.36+0.2	0.35+0.2
Drug content (%)	98.54+0.19	98.68+0.19	98.45+0.19
Drug Release (%)	98+0.09	97+0.18	97+0.23

Time	Cumulative % Drug Release	
	Before Stability Study	After Stability Study
	F3	F3
30	98+0.09	97.86+14

Table No.15: Cumulative percent drug released of optimized formulation before stability study after stability study

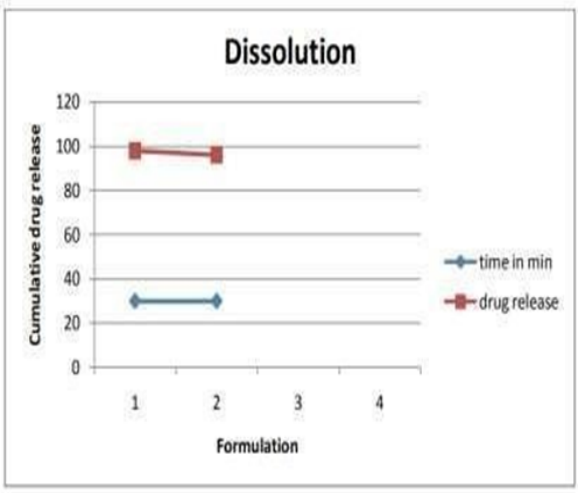

Figure No. 10 : Dissolution profile of formulations F3 before stability & after stability study

lV. CONCLUSION

The quick release pharmaceutical form is a new dose type that combines the benefits of convenience and ease of dosing. These pills are made to release the drugs more quickly. There is an unmet need for better manufacturing processes for immediate release pharmaceutical form that are mechanically robust, enable ease of handling and packaging, and have production costs comparable to those of conventional tablets because of the limitations of the current technologies, as

previously mentioned. Lisinopril conventional pills were designed to have steady, durable properties. The innovator's specifications were compared to the formulated tablets, and the optimized formulation met the requirements. Sodium Starch Glycolate, the formulation's super disintegrant, is distinct from that of the innovator, and even the binder is different from the innovator despite the evaluation's specifications being produced in accordance with them. Stability studies are conducted using the optimized formulation (F3), and the findings show good and acceptable I.P. limits. Perspective on the Future More cutting-edge IRT technologies should appear in the near future due to ongoing advancements in pharmaceutical excipients. These innovations could include combining new technical developments with conventional pharmaceutical processing methods to create innovative IRT dosage forms or altering formulation composition and processing to reach new performance end-points. It is realistic to anticipate that future developments in medication delivery systems will continue to integrate several technology fields to provide novel technologies.

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