IMMEDIATE RELEASE TABLET - REVIEW

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Abstract

This document provides a comprehensive overview of tablets as solid oral dosage forms, with particular emphasis on immediate release (IR) tablets. Tablets are defined as compressed pharmaceutical preparations containing active pharmaceutical ingredients (API) with or without excipients. The paper discusses the classification of tablets based on route of administration and release characteristics, including compressed, multi-compressed, delayed release, repeat action, sugar-coated, film-coated, and chewable tablets.

The focus is placed on immediate release tablets, which are designed to disintegrate and dissolve rapidly after administration to provide a quick therapeutic effect. The mechanism of drug release involves disintegration, deaggregation, dissolution (as described by the Noyes–Whitney equation), and absorption through the gastrointestinal membrane. The document elaborates on formulation components such as diluents, binders, disintegrants, lubricants, glidants, and flavoring agents, along with factors affecting drug release including solubility, particle size, compression force, and tablet porosity.

Preformulation studies such as organoleptic evaluation, FTIR compatibility studies, differential scanning calorimetry (DSC), and micromeritic properties (bulk density, tapped density, Carr's index, Hausner's ratio, and angle of repose) are discussed. The wet granulation method for tablet preparation is explained, followed by evaluation parameters including weight variation, hardness, friability, thickness, disintegration time, and stability studies as per ICH guidelines.

The study concludes that immediate release tablets remain one of the most widely used and clinically significant dosage forms due to their rapid onset of action, enhanced bioavailability, patient compliance, cost-effectiveness, and manufacturing simplicity. Continuous advancements

in formulation strategies and manufacturing technologies aim to further improve drug dissolution and therapeutic effectiveness.

Keywords

Immediate Release Tablets; Oral Solid Dosage Form; Wet Granulation; Disintegration; Dissolution; Noyes–Whitney Equation; Preformulation Studies; Drug–Excipient Compatibility; Evaluation Parameters; Bioavailability; Stability Studies; Pharmaceutical Formulation.

INTRODUCTION:

TABLETS:

Tablet is defined as a compressed solid dosage form containing medicaments with or without excipients. According to the Indian Pharmacopoeia Pharmaceutical tablets are solid, flat or biconvex dishes, unit dosage form, prepared by compressing a drugs or a mixture of drug with or without diluents.

ADVANTAGES:

1. Cost is lowest of all oral dosage.

2. 2.Light and compact.

3. Easier and cheapest of package and strip.

4.Easy to swallowing.

DISADVANTAGE:

1.Difficult to swallow in case of children and unconscious patients.
2.Drugs with poor wetting, slow dissolution properties.

Different types of Tablets:

(A) Tablets ingested orally:

1. Compressed tablet

2. Multi-compressed tablet

3. Repeat action tablet

4. Delayed release tablet

5. Sugar coated tablets

6. Film coated tablet

7. Chewable tablet

(B) Tablets used in oral cavity

1. Buccal tablet, e.g. Vitamin-c tablet
2. Sublingual tablet, e.g. Vicks Menthol tablet
3. Troches or lozenges
4. Dental cone

(c) Tablets administered by other route:

1. Implantation tablet
2. Vaginal tablet, e.g. Clotrimazole tablet

(D) Tablets used to prepare solution:

1. Effervescent tablet, e.g. Dispirin tablet (Aspirin)
2. Dispensing tablet, e.g. Enzyme tablet (Digiplex)
3. Hypodermic tablets.

1. Compressed tablet:

Compressed tablets are solid dosage forms of medication made by compression powdered or granulated drug substances with excipients into a hard, compact tablet using high pressure**. e.g. Paracetamol tablet**

2.Multi-compressed tablet:

Multi-compressed tablet is a type of compressed tablet that contains multi layers or components, each with a different formulation or API, compressed to get a single tablet. **e.g. Metformin**

3. Repeat action tablet:

Repeat action tablet also known as repeat dose tablet, is a type of modified release tablet designed to release the AP I **e.g. chlordiazepoxide**

4.Delayed release tablet:

Delayed release tablets are oral dosage form designed to release their active ingredients at a later time immediately after administration. **e.g. Omeprazole**

5.Sugar coated tablets:

Sugar coated tablets are solid oral dosage forms converted with multiple layers of sugar commonly used to mask bitter taste, hide unpleasant odors and improve the appearance.

e.g. Ibuprofen

6.Film coated tablet:

Film coated tablet is a type of coated tablet where the core tablet is covered with thin layer of polymer based coating material. **e.g. Metronidazole tablet**

7. Chewable tablet:

Chewable tablets are oral medications designed to be crushed and chewed in the mouth before swallowing. **e.g. Antacid tablet.**

IMMEDIATE RELEASE TABLET :

An **immediate release (IR) tablet** is a conventional type of oral solid dosage form designed to rapidly disintegrate and dissolve after administration, allowing for the quick absorption of the active pharmaceutical ingredient (API) and a fast therapeutic effect.This term excludes formulations which are adapted to provide for **"modified", controlled", "sustained", "prolonged", "extended"** or **"delayed"** release of drug. Immediate release dosage forms help in patient convenient dosage form or dosage regimen.

ADVANTAGE:

Rapid onset of action
Enhanced bioavailability
High patient compliance
Flexible dosing

DISADVANTAGE:

Frequent dosing requirement
Gastrointestinal (GI) irritation

EXAMPLE: Aspirin tablets, Ibuprofen tablets.

GOALS

- Quick therapeutic effect
- Enhance bio availability
- Bypass first-pass metabolism
- Fast disintegration and dissolution

MECHANISM OF IMMEDIATE RELEASE TABLET

Step 1: Disintegration:

- The tablet first **breaks apart into smaller granules or particles** when it comes into contact with GI fluids.
- This is facilitated by disintegrate (e.g., starch) that **swell upon hydration** and cause the tablet to rupture.

Step 2: Deaggregation:

- The granules further **break down into primary drug particles**.
- This exposes more drug surface to the solvent (GI fluid).

Step 3: Dissolution:

- The **drug dissolves** in the surrounding GI fluids according to the **Noyes–Whitney equation.dC/dt=DA(Cs−C)/h**

Where:

  - D = diffusion coefficient
  - A = surface area
  - Cs= drug solubility
  - C = concentration at time t
  - h = thickness of diffusion layer

Step 4: Absorption:

- Once dissolved, the **drug molecules pass through the GI membrane** by **passive diffusion or active transport**, entering the bloodstream to produce a therapeutic effect.

BASIC COMPONENTS OF IMMEDIATE RELEASE TABLETS

1.Active pharmaceutical ingredient **(**API).

2.Diluents.

3.Disintegrants.

4.Binders.

5.Lubricants.

6.Glidants.

7. Coloring and flavoring agents.

Active Pharmaceutical Ingredient (API):

The primary substance responsible for the intended therapeutic effect.

Diluents/Fillers:

These agents “fill out” the tablet, making it a suitable size for handling and administration when the API dose is small.

Disintegrants:

These are crucial for immediate release formulations as they facilitate the breaking apart (disintegration) of the tablet when it comes in contact with gastrointestinal fluid. **Examples**: sodium starch glycolate.

Binders:

These agents impart cohesive qualities to the powder mixture, ensuring the tablet remains intact after compression and improving flowability. They can be added as a dry powder or a solution during granulation. **Examples**: hydroxypropyl cellulose (HPC), and starch.

Lubricants:

Add a small amount of lubricant reduce friction between the tablets mixture and surfaces of the manufacturing equipment such as die wall and punches during compression.

Glidants:

These are fine powders that enhance the flowability of the powder or granules by reducing inter-particle friction, which helps ensure uniform weight of the final tablets.

Coloring and Flavoring agents:

These are added to enhance the appearance, taste and over all patient appeal of the tablet, enhancing the patient complaints.

Factors Affecting Immediate Release tablets

Drug solubility (hydrophilic vs. hydrophobic)

Particle size (smaller = faster dissolution)

Compression force (too hard = slower disintegration)

Type and concentration of disintegrant

Wet ability and porosity of tablet.

PREFORMULATION STUDIES

Organoleptic Properties:

Color, odor, taste, and appearance of the API are examined visually and manually. This is essential for early identification and selection of masking agents.

Drug excipients compatibility study (FTIR Study):

Obtain separate samples (pure drug and excipients and physical mixture of drug and excipients)

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Prepare a potassium bromide(KBr) pellet for each sample

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Grind the sample into fine powder

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Mix the powder with spectroscopic-grade KBr powder

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Press the mixture in a pellet die with a hydraulic press to form transparent disk

↓

Scan the sample (2500 to 25000nm or 400 to 4000cm^{-1}) (raw signal to generate the final spectrum)

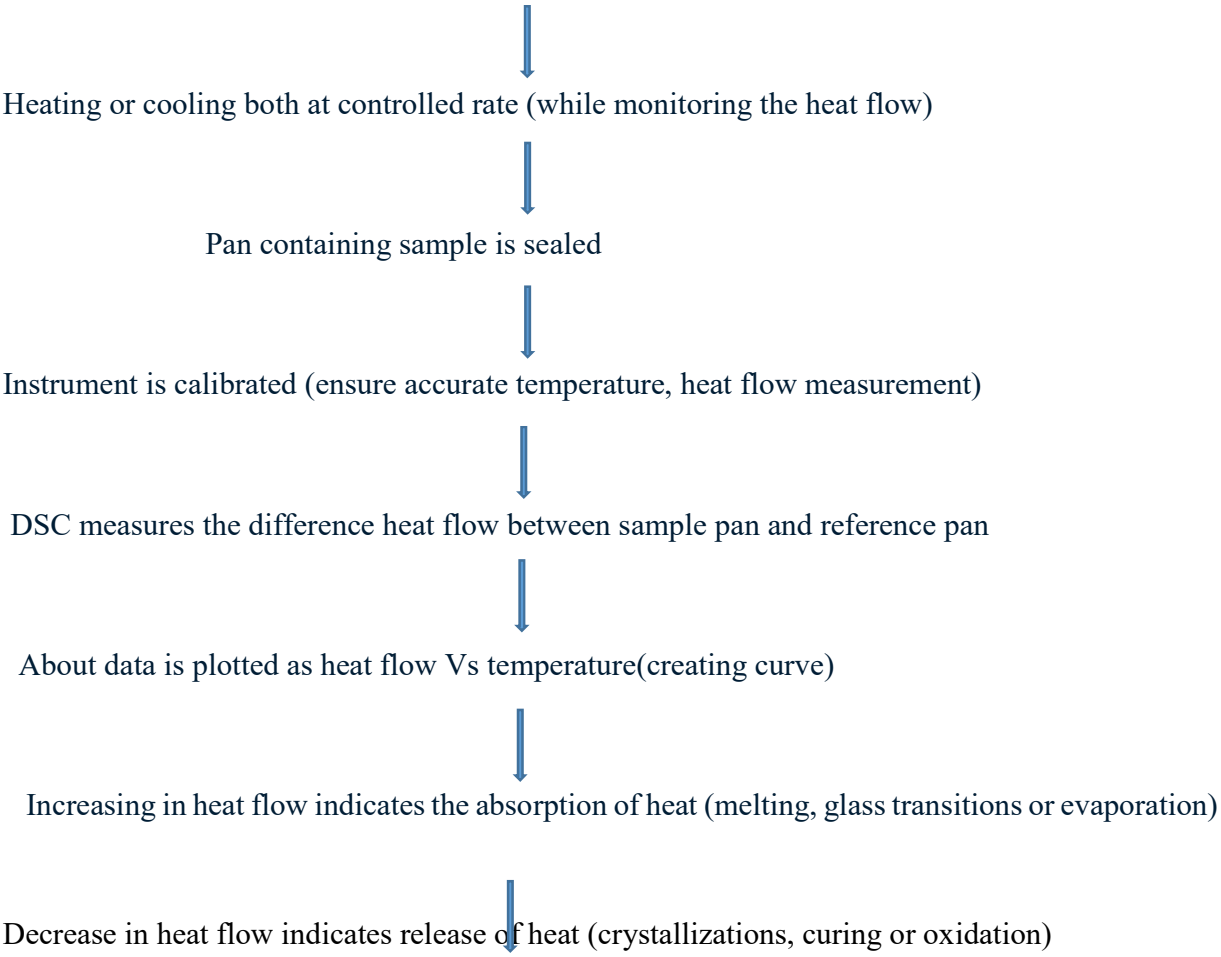
↓

Final spectrum collect

Analytical Techniques Used to Detect Drug – Excipients Compatibility.

Differential scanning calorimetry (DSC):

Placing a small sample in a aluminum pan and empty reference pan in the DSC instrument



Melting point:

Melting point was determined by a capillary tube closed at one end. The capillary tube was placed in an electrically operator melting point apparatus and the temperature at which the drug melt was recorded.

Bulk density:

Bulk density is the mass of a material divided by its total volume, which includes the volume of the particles and any pore space between them

Bulk Density = Mass / Volume

Tapped density:

Tapped density is the mass of a powder divided by the volume it occupies after being mechanically tapped to a constant volume.

Tapped density (TD) = mass of the powder/tapped volume

Carr's index:

Carr's index is also known as compressibility. It is indirectly related to the relative flow rate, cohesiveness and particle size.

Carr's Index (%) = (Tapped Density –Bulk Density) x100 / Tapped Density

Hausner's ratio:

Hausner ratio indicates the flow properties of the powder and measured by the ratio of tapped density to bulk density.

Hausner's Ratio = Tapped density / Bulk density.

Angle of repose (θ):

The angle of repose of API powder was determined by funnel method. Angle of Repose is defined as the maximum angle possible between the surface of a pile of the powder and the horizontal plane.

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

Where,

h = height of pile

r = radius of the base of the pile

θ = angle of repose

Angle of Repose	Flowability
<25	Excellent
25 -30	Good
30-40	Passable
>40	Very Poor

FORMULATION STUDIES

PREPARATION OF IMMEDIATE RELEASE TABLETS:

WET GRANULATION METHOD:

The active ingredient and excipients are weighed and mixed

The wet granulate is prepared by adding the liquid binder-adhesive to the powder blend and mixing thoroughly

Screening the damp mass through a mesh to form granules

Drying the granulation

A conventional tray dryer or fluid-bed dryer are most commonly used

After the granules are dried, they are passed through a screen of smaller size

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To create granules of uniform size.

Lubrication and final compression

EVALUATION STUDIES OF IMMEDIATE RELEASE TABLETS:

Weight variation:

Twenty tablets were randomly selected from each batch and individually weighed. The average weight and standard deviation were calculated.

IP limits for weight variation of tablet ranging from 80mg or less ±10 %.

Weight variation = individual tablet weight – average tablet weight x 100 / average tablet weight

Thickness Test:

The thickness of tablets was determined by using digital vernier calipers. It should be in a range of ±5% variation of a standard value. It's expressed in mm.

IP limits for thickness of tablet to be controlled within a ±5% variation of standard value.

Thickness = total thickness / no of tablets.

Hardness test:

Ten tablets from each batch were selected and hardness was measured using Digital hardness tester to find the average tablet hardness or crushing strength.

Hardness should be in between 3-6 kg/cm^2.

Hardness = applied force / surface area.

Friability:

The friability values of the tablets were determined using a Roche friabilator. It is expressed in %. 20 tablets were initially weighed (initial weight) and transferred to friabilator.

IP limit for tablet friability is not more than 1% weight loss.

% Friability = initial weight - final weight ×100/ Initial weight.

Disintegration Time:

The time taken for a tablet to breakdown into smaller particles in a liquid medium under standardized in test condition.

IP limit for disintegration time is lesser than 15 min.

Stability Studies:

The selected formulation was subjected to stability testing as per ICH guidelines. Indicated that the tablets did not show any physical changes i.e. color change, friability, and hardness during the study period. This indicates that the formulation of tablets was fairly stable at accelerated storage conditions.

The stability study for immediate release tablet as per the ICH guidelines during the storage condition in room temperature at acceleration (40^0 C/75%RH) for 6 months.

Intended label storage condition	Stability studies	Storage condition	Submission requirements
Room temperature	Long term	25°C/60%RH	12 months
	Intermediate*	30°C/65%RH	6 months
	Accelerated	40°C/75%RH	6 months
Refrigerator	Long term	5°C/Ambient	12 months
	Accelerated	25°C/60%RH	6 months
Freezer	Long term	–20°C/Ambient	12 months

* Test only if there is significant change at 40°C/75%RH

CONCLUSION

This is new enhanced oral product arising within this market there is a clear opportunity for new enhanced oral product arising with this larger market segment. Approximately one third of the patients need quick therapeutic action of drug, resulting in poor compliance with conventional drug therapy which leads to reduced overall therapy effectiveness. A new dosages format the immediate release (IR) pharmaceutical forms has been developed which offers the combined advantages of ease of dosing and convince of dosing. These tablets are designed to release the medicament with an enhanced rate. Due to the constraints of current technology as highlighted above, there is an unmet need for improved manufacturing processes for immediate release pharmaceutical strong to allow good packing and manufacturing by using above different super disintegrant and technology. To fulfill these medical needs, formulation have devoted considerable efforts to developing a novel types of tablet dosages for oral administration, one that disintegrant and dissolve rapidly with enhanced dissolution.

Immediate release tablets remain one of the most widely used and clinically important oral dosage forms due to their simplicity, patient acceptability, and cost-effectiveness.

It includes rapid therapeutic action, with, typically, 85% or more of the drug dissolving within 30 minutes to enhance bioavailability for acute conditions

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