WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Short Assessment on Tablet Coating Techniques : Review Article

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ABSTRACT

Applying a thin polymer-based film to a tablet or granule containing active medicinal ingredients is a common pharmaceutical process known as tablet coating (APIs). Coating solid dosage forms serves a number of purposes, the most crucial of which is to regulate the release profiles. The efficiency of the oral dose form depends on how much coating is there on the surface of a tablet. Typically, coating solutions for tablets are sprayed onto the tablet bed's free surface in horizontal rotating pans. Tablet coating has benefits such as disguising flavor and odor, providing physical and chemical protection, shielding the medication from the stomach environment, and more.

There are numerous tablet coating methods, including enteric coating, film coating, and sugar coating. The creation of coating techniques that get beyond the numerous drawbacks of solvent-based coatings has become a recent trend in pharmaceutical technologies. In the most recent technology, coating materials are applied directly, without the need of a solvent, to the surface of solid dosage forms. There are several types of solventless coatings, including electrostatic dry coating, magnetically assisted impaction coating, compression coating, hot melt coating, powder coating, and supercritical fluid coating. A cutting-edge tablet coating known as Supercell Coating Technology precisely deposits controlled amounts of coating ingredients on tablets, even if those tablets are highly hygroscopic or friable.

Aqueous film coating, electrostatic dry coating in solventless coatings, magnetically assisted impaction coating, and Supercell coating technology are other modern coating methods. Any cosmetic or functional flaws should not exist in a perfect tablet. The improvements and advances in tablet manufacturing have not reduced the production issues that are frequently encountered, but rather have worsened them due to the complexity of tablet presses and/or higher standards for quality. This review goes into great detail regarding the history, current tablet coating method, and tablet coating-related cures.

Keywords: - Tablet, Coating, History of coating, Supercell Coating, Magnetically Assisted Impaction Coating

INTRODUCTION

Tablets are pharmaceutical solids in the form of a mixture of active ingredients and excipients that are normally in powder form and compressed or solidified into tablets. One of the most popular dose formats worldwide is the structure of tablets. Tablets can be made from almost any pharmacological molecule, and the drug-making process is simple and adaptable.

Coating is a method of applying a thoroughly dried outer layer of coating fabric to the bottom of the dosage form in order to gain a particular advantage. Tablets, capsules, multiparticles, and drug crystals are only a few examples of the wide range of oral stable dosage forms that can benefit from the coating. The pill floor is covered with a tacky polymer film when the coating composition is applied to a batch of pills in a lined pan. The used coating transforms from a sticky liquid to a sticky semi-solid and then to a non-sticky dry floor pan before the surface of the pill dries. 1.

Many other types of potent medicinal dosages are produced by covering either the exterior of the pill or the fabric placed inside the gelatin capsule. The medications should be accessible for digestion and will gradually release the drugs. The coating method is primarily designed to alter how quickly the pill dissolves and where the active ingredient is meant to be taken into the body after consumption.

Definition

Pharmaceutical capsules are solid, flat or biconvex dishes that are organized using the compression of a capsule or a mixture of capsules, with or without diluents, according to the Indian Pharmacopoeia. The term "tablet" refers to a compacted, powerful dose form that contains medications with or without excipients. Depending on the amount of therapeutic ingredients and the intended manner of administration, they come in a variety of shapes and are noticeably different in size and weight.

Properties

1) The product must be based, have a unique identifier, and be devoid of flaws such chips, cracks, discolouration, and contamination.
2) It needs to be powered by electricity to withstand the strains of shocks experienced during production, packaging, transport, and dispensing.
3) Should possess the balance necessary to maintain its physical characteristics over time.

4) Must be able to consistently and predictably release the medication agent(s) into the body.
5) Must maintain a stable chemical equilibrium over time to prevent the therapeutic substance from changing (s).

Advantages

1) Tablets are unit dosage forms and offer the broadest range of capabilities among oral dosage forms for the best dose accuracy and the least content fluctuation.
2) They make the best and most affordable packaging and strip.
3) Low price.
4) Smaller and lighter.
5) Maintaining optimal chemical and microbiological harmony throughout oral dose
6) Effective for massive-scale production.
7) Easy to swallow with minimal hang-up potential.
8) The coating process can be used to disguise offensive odors and harsh tastes.
9) Enteric coating makes it possible to launch a product over time.
10) Simple to handle

Disadvantages

1) Difficult to swallow for individuals who are unconscious or youngsters.
2) Due to their amorphous and low density characteristics, some medicines defy compression into dense compacts.
3) It may be challenging to construct or manufacture a tablet for a medicine that has poor wetting, sluggish dissolution, or optimal absorption that is high in the GIT while maintaining appropriate or complete drug bioavailability.
4) Encapsulation or coating may be necessary for testing medications that are bitter, offensive-smelling, or oxygen-sensitive. Capsules may provide the best value in such circumstances.
5) Some solids' irritant effects on the GI mucosa (e.g., aspirin).
6) The potential for issues with bioavailability brought on by ingredients' gradual deterioration and dissolution In addition to active ingredients,

INGREDIENTS

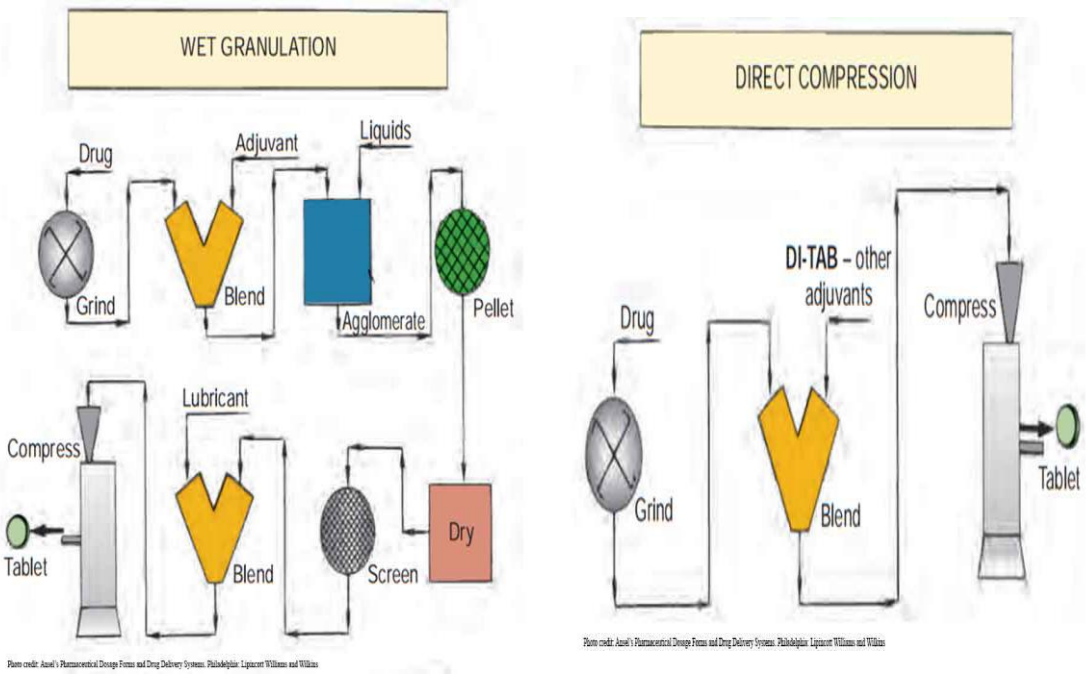
Functional role	*Examples*	*Description and functionality*
Filler	• Microcrystalline cellulose (MCC) • Lactose monohydrate or anhydrous • Mannitol • Sorbitol	• Add bulk to the dosage form • May contribute to dissolution and disintegration characteristics
Binder	• Polyvinylpyrrolidone (PVP) • Hydroxypropyl cellulose (HPC) • Starch	• Bind the powder ingredients to form granules for processing
Disintegrant	• Croscarmellose sodium (CCS) • Crospovidone (xPVP) • Sodium starch glycolate (SSG) • Starch	• Disintegration of the tablet to granules and powders on coming in contact with water
Glidant	• Colloidal silicon dioxide	• Aid the flow of granules/blend
Lubricant	• Magnesium stearate • Stearic acid • Sodium stearyl fumarate	• Aid the flow of granules/blend and ejection of tablets in the tablet press
Coating material	• Polymers such as hydroxypropyl methyl cellulose (HPMC), ethyl cellulose (EC), polyvinyl alcohol (PVA) • plasticizer (e.g., polyethylene glycol) • opacifier (e.g., titanium dioxide) • glidant (e.g., talc) • colorant (e.g., iron oxide red and/or yellow)	• Provide a physical barrier coating on the surface of the compressed core tablets
Coloring agent	• Iron oxide red and/or yellow • FD&C Blue #6	• Visual appeal of color
Stabilizer	• Antioxidants such as ascorbic acid, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), α-tocopherol	• Stabilization of the drug in the dosage form from stresses such as oxidation
Sweetener	• Aspartame, saccharin sodium, sucralose, acesulfame potassium	• Sweetening to overcome drug taste and/or improve palatability for some types of tablets
Flavoring agent	• Proprietary flavors (orange, pineapple, etc.)	• Flavoring to overcome drug taste and/or improve palatability for some types of tablets

tablet contains a number of inert materials known as additives or excipients. Different excipients are:

1) Diluents: When the medicine dosage alone is not enough to produce the necessary bulk of the pill, diluents are fillers utilized to do so. Additionally used to improve cohesion and enable direct compression.
2) Binders: to create cohesion compacts for a tablet that is compressed all at once.
3) Lubricants: Lubricants are designed to prevent the adherence of the ingredients in pills to the surfaces of dies and punches, reduce interparticle friction, and possibly even improve the rate of granulation of the pills.
4) Glidants: By reducing the friction between the particles, gliders are designed to encourage the drift of granules or powder fabrics.
5) Anti-adherents: These ingredients are added to pill formulations to prevent cloth from adhering to the pill press's partitions.
6) Disintegrates: Added to a pill to help it break or dissolve when it comes into contact with water in the gastrointestinal tract.
7) Coloring Agents: There are three reasons why colors and dyes are used in pills: (A) Masking of off-coloring medications (B) Product identification (C) Greater-based product production
8) Flavoring Agents: For chewable pills, flavoring oils are required. Usually, the oil is delivered in a dry form, such spray-dried beads.
9) Absorbents: If the product contains a component that has an excessive affinity for water, the addition of absorbents in the pill system is essential. If hygroscopic elements are included, the combination becomes damp and difficult to maintain at some point during manufacturing.

PREPARATION

Three methods are used to organize tablets.
1) The wet granulation method
2) The dry granulation method
3) Straight compression
1) Wet Granulation Method - This technique is the most popular and widely applied. This method requires a number of stages, including weighing the components, combining, granulating, and screening damp pass, as well as drying, lubricating, and compressing the tablets. Blending together the main energy component, diluent, and disintegrant, it is then permitted to pass through the sieve (sifting). Solutions of the binding agent are stirred into the first combination. To prevent overwetting of the pill, the amount of binding agent brought must be sufficient [46–60]. If the powder is not appropriately moistened, the granules will be excessively delicate and may break down during lubrication, which is difficult during tablet compression. The most common method of drying pill granules is tray drying. Tray drying was originally the method used the most frequently, however fluid-bed dryers could replace it as a revolutionary technology. The granules are permitted to pass through the screen, which is typically made of nylon material with a mesh size of 60 to 100, after drying. Following dry granulation, lubricant is given as high-quality powder, which is necessary for flawless die cavity filling.
2) Dry Granulation Method: This method is used to prepare pills. Slugging may also be employed to shape the granules if the tablet components are very sensitive to moisture or are unable to withstand high temperatures during the drying process. Dry granulation, also known as double compression, frequently removes many processes, including slugging the powder bulk. To build the slug, the active component, diluent, and lubricant are combined. The closing lubricant is then introduced to the granulation, blended true, and compressed to structure the tablets as the compressed slug is passed through the mesh or mill.
3) Direct Compression: This technique entails directly compressing the tablet-shaped powdered cloth. Direct compression is adopted, if drug constitutes fundamental element of pill [86-90] whole weight (Figure 1). With the right diluent, which serves as a service or vehicle for the drug, it is possible to create tablets with a drug content of no more than 25%. Tablets organized using the aforementioned
method are compressed on a desktop, which could have one or more stations.



TYPES

Oral Tablets for Ingestion

1) Standard Compressed Tablets
2) Multiple Compressed Tablets Compression Coated Tablets –
a) sugar coated, b) movie covered tablets, c) gelatin covered tablets, d) enteric lined drugs Layered pill Inlay pill
3) Targeted Tablets –
a) Floating Tablet, b) Colon Targeting Tablet
4) Chewable capsules
5) Dispersible drugs

Tablets used in the Oral Cavity

1) Lozenges and troches
2) Sublingual tables
3) Buccal pill
4) Dental cones
5) Mouth dissolved / hastily dissolving tablets

Tablets Administered by using different Routes

Vaginal pill
. Rectal pill
3. Implants

Tablets used to put together Solution

1) Effervescent capsules
2) Molded pills Hypodermic pill Dispensing /soluble pill
3) Tablet Triturate.

Structure Wise

1) Divisible Tablets
2) Aperture Tablet
3) Concave Convex Tablets
4) Core Tablet

Action Wise 1) Modified Release Tablet

Tablet coating

Tablet coating is a procedure by using which an truly dry, outer layer of coating cloth is utilized to the floor of a dosage shape in order to confer unique advantages over uncoated variety. Coatings might also be utilized to a range of oral dosage varieties such as particles, powders, granules, crystals, pellets and tablets.

Over the route of time, coating procedures have developed from the artwork of before years to these that are extra technologically superior and managed such that compliance with appropriate manufacturing practices (GMPs) is facilitated. The improvement and availability of new coating materials, the awareness of the have an impact on of utilized coatings on subsequent launch of drug(s) from dosage types and the development in tools graph have all contributed to elevated products.

the reasons for coating pills

1. To hide some medications' harsh flavor and unpleasant odor
2. To improve a product's appearance for commercial or aesthetic purposes (aiding in manufacturer identification)
3. To stop medication-induced inflammation at a specific location online within the gastrointestinal tract, such as the stomach in the case of NSAIDs (NSAIDs).
4. To protect the medication from the environment (especially air, moisture, and light) in order to improve stability.
5. To make eating large dosage forms easier
6. To make handling easier, especially in fast packaging/filling lines and automated pharmacy counters where the coating reduces cross-contamination by removing dirt.
7. To make it easier for the patient, the paying pharmacist, and the producer to quickly identify a product.
8. To reduce the risk of incompatible materials interacting
9. To prevent loss of substances that are unstable
10. To control and/or manage the cost of drug launch, such as in products with repeated action, delayed release (enteric coated), and sustained release.
11. To administer the online motion of capsules website, such as colon delivery
12. To prevent drug inactivation in the stomach, such as with enteric coating

Important factors affecting pill coating

1) Drug characteristics
2) The method, structure, and management of coating equipment

Coating technique variables Instruments and supporting tools Automating the coating process. The lined pill needs to have the necessary physical characteristics. An enclosed pan holds the rolling capsules. The medications must be wear- and tear-resistant in order to withstand the excessive putting on of various capsules or drugs that strike the coater wall. Process, graph, and manipulation of coating

In the majority of coating procedures, the coating solution is sprayed onto the pill as it is being stirred in a fluidized bed, pan, etc. Spraying the solution creates a thin film that instantly sticks to every tablet. The coating can be created using a single software program or layered using many spray cycles. Pharmaceutical companies frequently use rotating lined pans. Roll the uncoated tablets in a pan while adding the liquid coating solution to the pan. The liquid portion of the coating solution is then evaporated by blowing air across the surface of the rolled tablet. Contrarily, fluidized mattress coaters work by pumping air through the pill mattress at a rate sufficient to support and separate the pill as individual components. The capsules are sprayed with the coating substance after being split.

The following steps are often included in the coating process:

1. Batch naming and recipe selection (film or sugar coating)
2. Loading and dispense (accurate dosing of all required uncooked materials)
3. Warming
4. Misting (application and rolling are carried out simultaneously)
5. Drying
6. Cooling
7. Unloading

Tablet Coating Advantages

The coating on the tablets hides the drug's flavor, aroma, or color. The launch of the medicine from the tablet is controlled by tablet coating. Incorporate any other drug or formulation adjuvant in the coating to avoid chemical incompatibilities or to provide sequential drug release, improvement of pharmaceutical class through use of unique colorings and contrasting printing can also be obtained from pill coating. It provides bodily and chemical safety and protects the drug from the gastric environment of the belly (acid resistant enteric coating).

CLASSICAL COATING TECHNIQUES

Typically, there are three methods for coating pills.

- FIRST SUGAR COATING
- ADVANCED FILM COATING
- ENERGETIC COATING
- GRANULAR COATING:

The sugar coating procedure entails 5 distinct steps:

1. Sealing/water proofing: creates a barrier against moisture and hardens the surface of the pill.
2. Subcoating causes a quick increase in the pill's size and rounds off the corners.
3. Grossing/Smoothing: raises pill measurement to predetermined dimension while smoothing off the subcoated floor.
4. Coloring gives the pill its finished color and size.

Polishing results in the characteristics gloss3.

6. The characteristics of the sugar-coating strategy are listed below (Table1)

FILM COATING:

Creating Formulas for Film Coatings

- One can choose movie coating if the answers to the following questions are given simultaneously:

1. Is it essential to cover up offensive flavors, colors, and odors?
2. Is controlling drug release necessary?
3. What constraints in terms of size, form, or color need to be placed on the developmental work?

ideal requirements for film coating materials:

1. The desire's solvent's solubility for coating preparation
2. A requirement for solubility specific to the intended purpose, such as free water solubility, slow water solubility, or pH-dependent solubility
3. Ability to create a product based on research

High compatibility with various coating solution additives; 4. High stability toward heat, light, moisture, air, and the substrate being coated; 5. Lack of an inherent color, style, or odor; and 6.

7. Nontoxic and devoid of pharmacological action
8. Highly effective crack resistance
9. The debossed tablet must no longer be bridged or filled by the film forming.
10. Compatibility with printing methods

ENTERIC COATING:

Ideally, enteric coating materials should have the following properties: resistance to stomach fluids; susceptibility to/permeability to intestinal fluid.

• Compatibility with the drug substrate and the majority of coating solution ingredients.

The development of a continuous film.

Non-toxic, inexpensive, and simple to use; also, easily printable

The Following Polymers Are Used For Enteric Coating:-

Cellulose acetate phthalate, first (CAP)

Acrylate polymers, second

3. Hydrogenated hydroxypropyl methyl cellulose phthalate
4. Polyvinyl phthalate.

COATING DEFECTS ON TABLETS

Any observable or usable flaw must be absent from a flawless medication. Because of the complexity of pill presses and/or the growing demands for quality, advances and improvements in the manufacture of pills have exacerbated rather than reduced the challenges that are frequently faced in production. During production, an industrial pharmacist frequently runs into a wide range of problems.

The majority of observable flaws are caused by inadequate fines or moisture in the granules ready for compression, or by incorrect computer settings. Formulation errors are the cause of functional faults. Many production issues can only be resolved with in-depth knowledge of granulation processing and pill presses, which is only acquired by thorough research and successful experience. 17,18,25.

Here, we shall discuss the flaws found in medications, as well as the causes of such flaws and possible remedies (see desk no. 5). Numerous drugs are being tested in discernment number 11. The flaws are known as "VISUAL DEFECTS," and they both relate to flaws in every body or greater of the following factors:

Tablet Coating Defects: Causes and Solutions

Table II: Examples of common defects that can be avoided by suitable process design.

Defect	Description	Example	Approaches to minimize defects
Film cracking (type 1)	Coating cracks due to thermal expansion of tablet cores and lack of film flexibility caused by overdrying.		1. Reduce processing temperatures to minimize core thermal expansion. 2. Reduce drying conditions (or increase spray rate) so that some moisture retention in the coating occurs to augment plasticization effects (thus increasing film flexibility).
Film cracking (type 2)	Coating cracks due to core swelling caused by excessive moisture uptake into tablet cores during application of coating.		1. Improve drying (reduce spray rate or increase temperatures) to offset overwetting. 2. Increase pan speed to minimize dwell time in spray zone. 3. Use high-solids coating systems to reduce moisture burden on the drying process.
Logo infilling	Partially spray-dried material has accumulated within the logo, obscuring the clarity of the logo design.		1. Minimize foam generation during preparation of coating suspension. 2. Reduce atomizing conditions and/or reduce drying conditions to minimize the risk of spray drying.
Rough coatings	The coating deposited on the tablet surfaces is excessively rough either as a result of partial spray drying or because of overwetting, causing soft coating to rub.		1. If roughness is caused by partial spray drying, reduce atomizing conditions and/or reduce drying conditions to minimize this effect. 2. Reduce coating solids if viscosity is too high for effective atomization. 3. If roughness is caused by overwetting, improve drying conditions in the process.
Delayed dissolution for immediate release (IR) products	Tablets show delayed dissolution after application of film coat (often associated with exposure of tablet cores to coating process conditions rather than a direct effect of the applied coating).		1. Adjust process conditions to facilitate a reduction in processing temperatures (heat is often a primary factor with this problem). 2. Use high-solids coating system to enable use of lower processing temperatures.

CONCLUSION

In current decades, coating of pharmaceutical dosage types has been problem of fantastic developmental efforts aiming to make sure and beautify the best of pill dosage form. Magnetically assisted impaction coating and electrostatic dry coating avoids foremost risks of solvents primarily based coating.

Methods produce uniform coating however solely with specialised instrumentation. Electrostatic dry coating requires extraordinary kind of powder coating composition. Electrostatic dry coating permits coating of pill with distinctive colorations on both aspect along-with printing on tablet on pharmaceutical dosage form.

Safety components of these coatings in human beings is nevertheless to be unveiled consequently similarly lookup in fitness and security factors of these applied sciences will make certain the commercialization of these applied sciences in pharmaceutical industry. Improvements concerning particle movement, warmness and power transfer, movie distribution, drying effectivity and non-stop processing have contributed to appreciably boost this technology. However assessment and success of similarly constructional enhancements in coating techniques appear to rely on correct analytical equipment and superior strategies for system modelling and control. In this regard, reaching most efficient manufacturing effectivity and excessive product first-class nonetheless stays a main task for future research.

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