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A REVIEW ON TABLET MODIFIED DRUG DELIVERY AND COATING TECHNOLOGY

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ABSTRACT:

Tablets are one of the most convenient and widely used solid dosage forms. A tablet is a compressed dosage form that may or may not contain an active drug. Coating is defined as a tablet or granule coated with a dry outer film to achieve specific goals such as masking the taste of the desired dosage form or protecting it from environmental conditions. The coating types are sugar coating, film coating, gelatin coating, enteric coating and compression coating technology. These devices are usually used to cover the outer layer of the tablet with a thin film that acts as a coating material. The purpose of the entire film was to prevent physical or chemical damage to the tablet and mask unpleasant odors, smells and tastes. Polymers play an important role in coating technology; are often used as flavor maskers and film-forming agents to modify the delivery of dosage forms.

***INDEX TERMS*: Tablets, Coatings, Modified drug delivery, Tablet evaluations.**

I. INTRODUCTION

Tablets are one of the most convenient and preferred oral dosage forms due to many advantages such as convenience, greater patient compliance, and cost effectiveness. Coating is an important process among several steps in tablet manufacturing, often used for functionality and quality.[1] Aesthetic qualities such as texture, color, mouth feel, and taste mask depend on the coating method.[2] These coating methods have certain limitations or weaknesses to overcome these limitations. Tablets are one of the best alternatives.

Tablets are one of the most convenient and widely used solid dosage forms. A tablet is a compressed dosage form that may or may not contain an active drug. They differ in size, shape and weight depending on the method of use and the active ingredients used of all dosage forms, about 70% to 75% of medications are administered in tablets. [3] Tablets have several advantages over other dosage forms, such as precise dosage, performance, and patient compliance, as they are produced in large volumes. [4]

II. Coating

Coating is defined as a tablet or granule coated with a dry outer film to achieve specific goals such as masking the taste of the desired dosage form or protecting it from environmental conditions. Coating materials can consist of coloring materials, rubber, flavors, wax, resin, plasticizer, and polyhydric alcohol. Today, polysaccharides and polymers are mainly used as coating materials together with other agents such as plasticizers and pigments. To make the coating strong and stable, many measures must be taken into account in the coating process. According to the International Council for Harmonization (ICH) guidelines, organic solvents are avoided in formulating drug dosage forms due to safety concerns.[5] Tablets affected by moisture or oxidation should be coated using the FC method. This method can increase the shelf life, mask the bitter taste, and increase the coating defense which makes it easier to swallow. Chitosan and other muco-adhesive polymers have been used to coat tablets to attach these tablets to rigid membranes and provide sustained drug release at localized sites. [6]. Recently, the coating of dosage forms using biopolymers has been widely studied. [7] Light-sensitive active pharmaceutical ingredients (APIs) can be provided by encapsulation with emollients. Similarly, enteric-coated tablets reach the intestine after a longer period of time and may help maintain the efficacy of acid-labile APIs.[8]

Among the three types of tablet coating (sugar coating, film coating, and press coating), film coating is the most widely used method to solve various problems during production, storage, transportation, and clinical use.[9] For example, tablets containing active pharmaceutical ingredients (APIs) that are sensitive to light, oxidation, or moisture can be provided with a film layer, resulting in the stability of the drug product during manufacturing and storage. In addition, film coating can control the release of drugs from tablets in terms of speed, location and time. [10,11,12]

III. Objectives of coating [13,14,15]

The purpose of the tablet cover is as follows:

Masking the unpleasant smell, color or taste of tablets and improving patient compliance.

Protect the drug from the environment (especially moisture, air, and light) to provide physical and/or chemical protection for the drug and improve stability.

- To lengthen the shelf life of the drug.
- In improving product robustness.
- To delay loss of volatile ingredients.
- To increase ease of swallowing large dose forms.
- Increasing the mechanical p of the dosage form
- Masking batch differences in the appearance of raw materials.
- To include incompatible drugs together in a single dosage form
- Improving product appearance and help in identification by the manufacturer, the pharmacist and the patient (mostly colored).
- To modify and/or regulate the rate of drug release as in repeat-action, delayed release (enteric coated) and sustain-release formulations.

IV. Benefits of coating

The coating gives the tablets stability in handling and prevents them from sticking together. Coatings also increase the mechanical strength of the dosage form, making the dosage form softer and more acceptable for swallowing.[16] The pharmaceutical industry can print logos, labels or abbreviations on the tablets to mask the unpleasant color or smell of the tablets. The release of the active ingredient can even be controlled by the coating. Covered dosage forms may be site specific. It inhibits the adverse effects of acid-sensitive drugs in the gastrointestinal tract (GIT). The rate of drug release in the gastrointestinal tract can be regulated by controlling tablet dissolution.[17]

Type of coating:

Various tablet coatings are used to improve the variable properties of tablets, from hiding bitterness, promoting ease of swallowing, protecting tablets from damage or external forces, and creating branded tablets for marketing purposes increase tablet shelf life.[18-22]

Sugar Coated Tablets

Do you have a bitter regret in your mouth when managing on a tablet? This type of coating provides a sweet coating made of polysaccharides and sucrose to mask the bitter taste of the tablet. The sugar coating gives a pleasant aroma to aromatic herbs such as fish supplements. The sugar syrup is covered with a tablet and the water is left to evaporate from the wine, leaving a coating of sugar. The coating creates a highly palatable and glossy tablet. [18] Sugar-coated tablets are usually used for children.

1.Film Coated Tablets

This is the most widely used coating in the pharmaceutical industry today. This coating is used to improve the purity and taste of the tablets. Tablets, especially those made from plant extracts, are not graphically attractive, so a coating is needed to replace the tablet with a unique color. In other cases, not all tablets need a jacket, only a film to keep the original color. A spray is used to create an even film around the tablet [19,20]. This type of tablet creates a stable and strong tablet, a tablet brand color and an identifiable coating.

Gelatin Coated Tablets

Gelatin is a type of protein formed from the limited hydrolysis of collagen. It is found in animal parts and contains amino acids, which are the 'building blocks' of proteins. Gelatin is used as an outer coating to form a cap-shaped gel capsule. Gelatin-coated tablets provide a protein-rich coating [21].

Enteric Coated Tablets

This coating provides an acid-resistant coating for tablets containing acid-sensitive ingredients. If the tablet is to be absorbed in the small intestine, then the tablet must resist stomach acid and reach the target site where it is slowly absorbed in the absence of acid.

This type of tablet should not be crushed or chewed to avoid the risk of damage due to stomach acid reaction. [18, 21]This type of tablet delivers the drug to the intestine without harming the user.

Compression Coating Tablets

It involves compression of granular particles around assign tablet using special equipment through a dry process. It is less common than the rest and consists of the outer covering and an internal core. The delayed release of tablet especially those for intestines.[22,23]

Equipment's used for tablet coating:

These devices are usually used to cover the outer layer of the tablet with a thin film that acts as a coating material. The purpose of the entire film was to prevent physical or chemical damage to the tablet and mask unpleasant odors, smells and tastes. The coating also protects the tablet from the gastric environment and promotes sustained drug release. The coating also strengthens the sides of the tablet. [24]

The equipment used for coating purposes is designed on a simple principle: the coating is applied to the tablet as a solution while the rotator moves vertically or horizontally. During the rotation, a stream of hot air is also introduced to help evaporate the solvent. The continuous movement of the bed causes the coating material to spread and even dry on the tablet.[16]

Types of coating Equipment:

- Standard Coating Pan
- Perforated Coating Pan
- Fluidized Bed Coater / Air Suspension System

1.Standard Coating Pan

A typical cover panel gadget consists of a circular steel plate mounted on a stand, typically in an angular position. The boards are 10-60 inches in diameter and are rotated horizontally by a motor. Hot air is sent to the surface of the boiler and tablet bed. It is exhausted by the channel position in front of the board. The coating solution is transported to the drug by spraying or spraying them on a rotating bed. It is applied to the tablet bed by coating or spraying the coating solution. The use of an atomizing system to spray the liquid coating material on the tablet ensures rapid dispersion of the solution or suspension. Spraying can significantly reduce the drying time between applications of the solution in the sugar coating procedure and allow the use of the solution in film coating. [24,25]

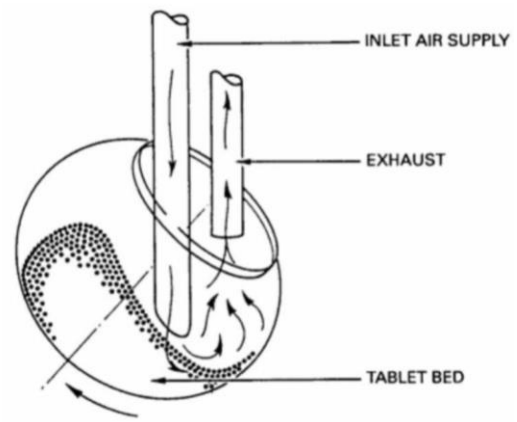

Figure 1: Standard coating pan

2.Perforated Coating system

The perforated casing system uses either a fully rotating or partially perforated drum that rotates in a closed housing on a horizontal axis. Drying coating material with perforated coating system is better than other conventional methods. This system pays off big time. [26]

Examples of perforated coating pans include:

1.Accela-cota & Hi-coater systems

2.Driacoater

3.Glatt coater

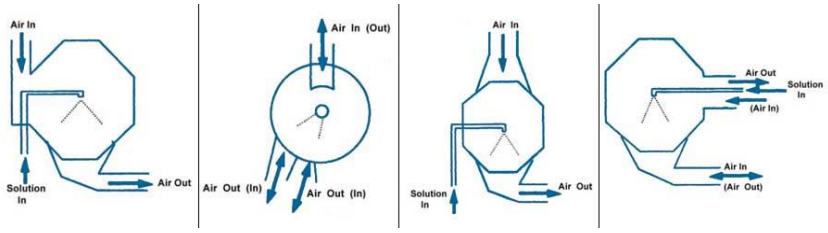

Figure 2: Perforated Coating system

3.Fluidized Bed Coater / Air Suspension System

The fluidized bed is a high-tech drying system. Liquefaction of the tablet mass takes place in the column chamber with a high flow of drying air. The air flow is manipulated to draw more air into the center of the column, causing the tablet to rise in the middle. Some units use sub-columns to control the movement of the tablet in the main column. The coating solution is applied continuously to the bottom of the chamber with a spray nozzle located above the bed chamber. [25-27]

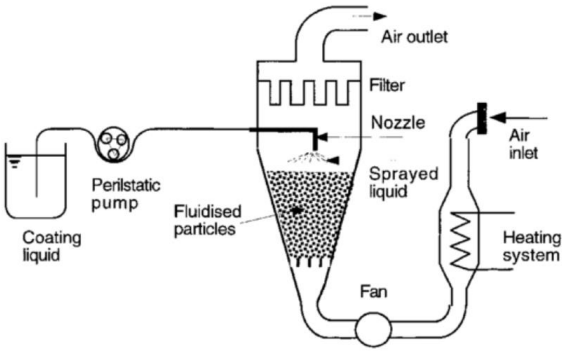

Figure 3: Fluidized Bed Coater or Granulator

Tablet Coating Evaluation:

Before a tablet is released out into the market it has to pass a some quality checks, which is compulsory. Evaluation of tablet includes the assessment of tablets chemical, physical, and biological properties. To studies them the following tests are formulated. [28]

- Appearance,
- Size and Shape,
- Organoleptic properties,
- Uniformity of thickness,
- Hardness,
- Friability,
- Drug Content Uniformity,
- Weight Variation Test,
- Wetting time,
- Water Absorption Ratio,
- In vitro Dispersion Time,
- In vitro Disintegration Test,
- In vitro Dissolution Studies,
- Two set of apparatus.

Tablet Modified drug release technology:

There are many different methods used to obtain a sustained release.

1.Diffusion systems:

The release rate of a diffusion system depends on the rate at which the drug dissolves through the barrier, usually some type of polymer. Diffusion systems can be divided into two subcategories, reservoir devices and matrix devices. [29]

● The reservoir device coats the drug with a polymer, and for continuous release from the reservoir device, the polymer should not dissolve and the drug should not be released by diffusion [29] The speed of the reservoir device can be changed by changing the poles and zero-order discharge is possible; however, drugs with high molecular weight have difficulty diffusing through the membrane. [30,31]

● The matrix device forms a soluble/dispersible matrix medicine. [32] The drug is usually dispersed in the polymer and then released by diffusion. However, to produce SR in this device, the drug access rate in the matrix must be higher than the release rate. Matrix devices cannot achieve zero-order extraction, but higher molecular weight molecules can be used. [33] Diffusion matrix devices are easier to manufacture and are protected from gastrointestinal disturbances, but factors such as diet can affect the rate of release. [33]

2.Dissolution systems:

The system must be continuously dispersed for a constant drug release, which can be achieved by using continuous salts and/or derivatives, as well as by coating the drug with solvent materials. [29] It is used for medicinal amalgam with high water solubility. [6] When the drug is protected by a slow-dissolving coating, the drug will eventually release. The location of drug diffusion depends on the dissolution and layer thickness. Dispersion due to this mechanism will be a limiting factor for drug release. Separation systems can be divided into subcategories called reservoir devices and matrix devices. [32]

The waterproofing device covers the drug with a suitable material that dissolves slowly. Additionally, it can be used to manipulate beads as groups with different thicknesses, creating SRs that repeatedly release drugs. [29, 32]

In matrix devices, the drug is contained in the matrix and the matrix dissolves instead of the coating. The medicine can be absorbable spheres or tablets impregnated with medicine. [32]

3.Osmotic systems:

Osmotically controlled oral delivery systems (OROS) consist of solid tablets with a semipermeable outer membrane and one or more small laser-drilled cores. When the tablet passes through the body, water is absorbed into the semipermeable membrane by osmosis, and the resulting osmotic pressure is used to push the active drug through the opening of the tablet. RUS, a brand owned by ALZA Corporation, pioneered the use of osmotic pumps for oral drug delivery. [33-35]

Osmotic release systems have major advantages over other controlled mechanisms. Food intake appears to be less dependent on factors such as pH, GI motility, and various gut environments. Using an osmotic pump for drug delivery has additional advantages in controlling drug delivery. This allows for more precise drug delivery over a longer period of time, resulting in more predictable pharmacokinetics. However, osmotic release systems are relatively complex, difficult to manufacture, and may cause irritation or obstruction of the gastrointestinal tract due to prolonged release of irritating drugs from unreformed tablets. [33-38]

4.Ion-exchange resin:

In the ion-exchange method, the resins are cross-linked water-insoluble polymers that contain ionisable functional groups that form a repeating pattern of polymers, creating a polymer chain. [29] The drug is attached to the resin and is released when an appropriate interchanges of ions and ion exchange groups occur. The area and length of the drug release and number of cross-link polymers dictate the rate at which the drug is released, determining the SR effect. [32]

5.Floating systems:

A floating system is a system that floats in the gastric fluid due to its low density. The density of gastric fluid is about 1 g/ml; therefore controlled tablets must have a small density. Sedation will allow the system to float to the top of the stomach and exit slowly without fear of expulsion. This system requires the presence of adequate gastric fluid with food. [29] Many types of medicine use this method, including capsules, powders, and tablets. [39]

6.Bio-adhesive systems:

Bio-adhesive systems are usually designed to adhere to mucus and can ensure oral adhesion due to high mucus content in general areas, but not easily for other areas. Magnetic material can be added to the drug, so another magnet can hold it outside the body to help keep the system in place. However, patient compliance with this system is low. [29]

7.Matrix systems:

The matrix system is the combination of materials with the drug, which will cause the drug to slow down. However, this system has several subtypes: hydrophobic matrices, hydrophilic matrices, lipid matrices, mineral matrices, and biodegradable matrices. [29]

8.Stimuli inducing release:

Examples of stimuli that can be used for deposition include enzymes, pH, light, magnetic fields, ultrasound, temperature, osmosis, cellular traction forces, and electronic control of MEMS and NEMS. [40,41]

Micro-spherical hydrogels with 3-dimensional cross-linking polymers can be used as drug carriers to modulate drug release. These hydrogels are also known as microgels. As DC beads, they can have a negative charge. Through the ion exchange mechanism, large amounts of oppositely charged amphiphilic drugs can be loaded into these microgels. Then, the release of this drug can be controlled by specific driving factors such as pH, ionic strength, or temperature. [42]

CONCLUSION:

Coating a solid dosage form, such as a tablet, is a common concept, but it is the sensorial process that gives tablets their distinct properties. Solid dosage forms increase the cost, are administered orally, and thus meet a variety of clinical needs. Since tablet coating is a technology-driven process, it depends on the application of the coating technique, the equipment used for the coating process, the inspection of the coated tablet, and the coating material used. Polymers play an important role in coating technology; are often used as flavor maskers and film-forming agents to modify the delivery of dosage forms. The biological properties shown for Jarilla extracts would justify the use of extracts from this species for the development of phytomedicines and/or phytocosmetics and/or food products.

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