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Overview: Article on Extended-Release Tablet

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Abstract: *The usage of pan coating was justified in large firms because of the size of their product batches. A comparatively small number of people might economically coat thousands of pills or tablets. today. Pharmaceutical coatings have entered a new age. Tablet coating developed into what it is now over the first half of this century. Over the past century, there hasn't been much change in glaze bread. Stainless steel has taken the place of copper pans, which were once used in confectionary. The process of applying an exterior dry layer on a chosen dosage form, like granules or tablets, in order to accomplish a particular goal, like taste masking or environmental protection, is known as the coating process. Dyes, flavours, gums, resins, waxes, and plasticisers are examples of coating materials. Nowadays, the most common coating materials are polymers and polysaccharides, combined with additives like colours and plasticisers. The FC technique should be used to coat tablets that are prone to oxidative deterioration and moisture. The durability and mask will be enhanced by this process. forms a smooth shell that is simple to swallow and conceals bitterness. The pills were coated with various mucoadhesiveness polymers, and chitosan stuck to them. creation of a coating technique to target long-term release of active substances and penetrate mucosal membranes. Coating was first conceptualised in antiquity. Psyllium was initially utilised by Rhazes to cover up the flavour of the tablets. Avicenna reportedly applied gold and silver coatings on the tablets.*

Keywords: Tablet

I. INTRODUCTION

The practice of covering a desirable dosage form, like a pill or granule, with an exterior dry film in order to accomplish particular objectives, including concealing taste or providing protection from environmental factors, is known as coating. The coating substance could contain polyhydric alcohol, gums, resins, waxes, flavorants, colourants, and plasticisers. In the contemporary age, polymers and polysaccharides were the most commonly utilised coating materials, along with various excipients like plasticisers and colours. To guarantee the coating's consistency and longevity, numerous safety measures must be implemented throughout the application procedure. Because of safety concerns, the International Council for Harmonisation (ICH) forbids the use of organic solvents in the formulation of pharmaceutical dosage forms. [1].

The current dose form can be changed to address this. The idea of tablets as a solid dose form was initially proposed around 1500 BC. Ancient Egyptian pills originated from papyri. The FC technique must be used to coat tablets that are susceptible to oxidation or moisture deterioration. Its mask and shelf life could be increased with this method. It will produce a smoother covering and cover up the bitter flavour, making swallowing easier. Tablets were coated with chitosan and other mucoadhesive polymers to help them stick to mucous membranes and provide targeted, sustained medication release [2].

The compressed tablet was created in 1844 by Professor Brockedon of England. There was no indication of the pills' solubility or breakdown time, and they were hard. In 1871, Mr. Newbery bought the Professor Brockdon store. Oral solid dose form (DF) is the most practical dosage form. It is available at pharmacies. They were first produced several millennia ago. These DFs have a number of benefits, including as strong patient compliance and reasonably easy and convenient production.[3].

The advent of methods like tablet coating, twofold compression, and osmotic systems has allowed members of this class to progress in recent decades. to accomplish a controlled and targeted discharge. Numerous methods can be used

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to get this coating. The most popular methods are compression coating, microencapsulation, sugar coating, and film coating. An old method for FD coating is sugar coating [4].

The FC technique must be used to coat tablets that are prone to oxidation or moisture deterioration. Its mask and shelf life may be increased by this technique. It will provide a smoother covering and cover up the bitter flavour, making swallowing simpler. The pills were coated with various mucoadhesive polymers and adhered using chitosan. To accomplish long-term, tailored drug release via mucosal membranes [5].

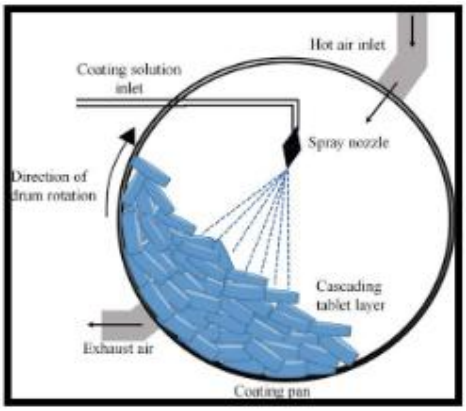

Fig 01- Tablet coating diagrammatic view

Mechanisms of Film Formation Aqueous film coating

Applications might be either solutions or dispersions, depending on how soluble the film-forming polymer is in water. Polymer solutions undergo phased film formation. When the polymer solution is applied to the tablet's surface, cohesive forces create bonds between the coating's polymer molecules [13].

The continuous surface of the film material should grow together and the cohesion of the polymer molecules should be reasonably high in order to achieve high cohesion. Adjacent polymer molecular surfaces or layers coalesce as a result of diffusion. The viscosity of the solution increases (gelation) as most of the water evaporates, holding the polymer chains together and allowing them to deposit on top of the prior layer of polymer [14].

Using aqueous polymer dispersions rather than organic polymer solutions results in a fundamentally different mechanism of film formation, but as the residual water evaporates more thoroughly, the individual polymer chains align into a coherent film with sufficient cohesive forces between molecules as well as sufficient diffusion and coalescence [15].

When these are sprayed onto the surface, the organic solvent evaporates, bringing the polymer chains closer together and finally forming a cohesive, homogeneous film. On the other hand, when the aqueous polymer dispersion is sprayed onto the surface of the dosage form, the water evaporates and the polymer particles are brought closer together and the appropriate conditions (especially temperature, presence of the sufficient amount of water and/or other plasticizers) are applied.) below. Forms a uniform polymer film [16].

In practice, it is often difficult to ensure perfect film formation during coating. Therefore, a thermal post-treatment (curing) is usually performed to complete the coalescence of the polymer particles. Film formation from a dispersion liquid fuses polymer particles to form a continuous film, so the mechanism is more complicated than film formation from a solution [17].

Compression Coating-

Granular material is squeezed around a pre-formed tablet core using specially made tableting equipment. It is a dry compressive coating. It is useful when the tablet core needs to be coated to cover the taste or give the product an enteric or delayed coating because it cannot tolerate organic solvents or water [18].

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Dip coating

The tablets are coated by dipping them in a coating solution and then the wet tablets are dried in a conventional coating pan. Alternating soaking and drying steps can be repeated several times. The desired coating is achieved [19].

Enteric coating

Barriers called enteric coatings regulate where an oral medication is absorbed in the digestive tract. "Gut" is a term that describes the small intestine. Drug release is thus stopped before it enters the small intestine by an enteric coating. At low pH, enteric-coated polymers stay bonded and are hence insoluble. However, the polymer swells or becomes soluble in intestinal fluids when the pH of the GIT rises because the acidic functional groups ionize [20].

Table 1- Various polymer used for enteric coating formulations

Sr no	Polymers
1	Shellac (esters of aleurtic acid)
2	Cellulose acetate phthalate (CAP)
3	Poly(methacrylic acid-co-methyl methacrylate)
4	Poly(vinyl acetate phthalate) (PVAP)
5	Hydroxypropyl methylcellulose phthalate (HPMCP)

Aqueous film coating-

Water is now the chosen coating solvent due to the aforementioned issues with organic solvents. Compared to organic-based coatings, aqueous coatings are becoming more and more popular [27].Although upgrading the coating line initially may require a minor investment, switching from organic solvent-based coating to water-based coating makes the coating process more cost-effective. The necessity for more drying capacity necessitates this upgrade. In comparison to organic solvents, four times as much energy is needed [28].

Recent technique in tablet coating

Electrostatic coating-

It works well for adding layers to conductive materials. Strong static electricity charges the board. The charged substrate is sprayed with a coating substance made up of conductive ionic species that are oppositely charged. The corners of the substrate are coated completely and consistently. [29].

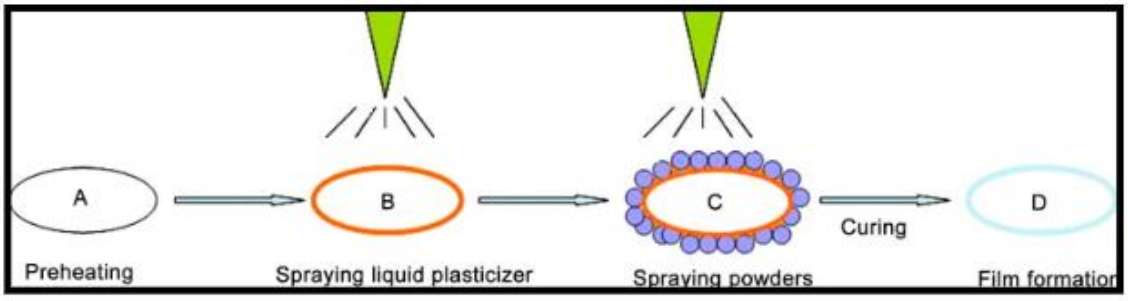

Fig 03- Schematic diagram electrostatic coating

Corona charging-

This happens when a high voltage is applied to a pointed, needle-like electrode (charging pin) at the gun's exit, causing electrical breakdown and subsequent air ionization. As the powder particles travel from the cannon to the substrate, they absorb negative ions. Electrical and mechanical forces work together to determine particle motion between the charge gun and substrate.

The powder is forced onto the substrate from the spray gun by a mechanical force produced by the air [30].

The electric field between the soil and the charged spray gun tip, as well as the repulsive interactions between the charged particles, produce the electrical force in the corona charging scenario. The gun's powder flow, as well as the control pattern's size, shape, and density, can all be altered by varying the electric field [31].

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Magnetically assisted impaction coating (MAIC)-

Numerous dry coating techniques, including pressure coating, plasticiser dry coating, heating dry coating, and electrostatic dry coating, have been developed. In order to accomplish coating, these techniques typically permit the employment of significant impact forces or auditory loads in addition to exposure to high temperatures. The guest particles may become layered and even entrenched on the surface of the host particles as a result of the strong mechanical forces and associated heat [34].

A large number of components used in food and medicine are organic, somewhat soft, highly heat-sensitive, and easily distorted by powerful mechanical pressures. For these kinds of applications, a soft coating method that permits guest particles (coating material) to stick to host particles (material to be coated) with less deterioration is a superior option. Devices that use magnetically-assisted impaction coating (MAIC) can coat soft organic host and guest particles without significantly altering the size or form of the substance [35].

Vacuum film coating-

This innovative coating process uses a baffle plate that has been particularly created. The water jacket is attached to the hot pan. is capable of being sealed to establish a vacuum system. Before the necessary vacuum level is reached, put the tablets in the pot and use nitrogen to remove any remaining air. To apply the coating fluid, an airless spray mechanism is employed. Vapoursare extracted from the evaporated solvent using a vacuum apparatus. It is possible to use organic solvents effectively. High environmental safety is also in place, as are these coating methods [36].

Polymers used in coating-

Rosin [38]-

Pharmacological research on rosin, a biopolymer that forms films, and its derivatives as film-coating and microencapsulation materials for sustained drug release has been considerable. Additionally, toothpaste, chewing gum, and cosmetics include it. To make spherical microcapsules, rosin was employed in a procedure based on phase separation by solvent evaporation. Dibutyl phthalate, polyvinylpyrrolidone, and rosin combined at a 30% w/w ratio produce smooth films with enhanced tear strength and elongation.

D-glucose, chitosan, and chitin An enzyme called chitinase breaks down chitin. N-acetyl-glucosamines (acetylation units) and D-glucosamines (deacetylation units) are randomly dispersed polysaccharides that make up chitosan. The most significant characteristic of chitosan in medication administration is its positive charge in acidic environments. This positive charge is caused by the protonation of its free amino group.

Starches [41]-

It is the primary type of carbohydrate that green plants store, and it is particularly present in seeds and subterranean organs. The size and structure of the granules, which are a kind of starch, as well as the proportion of the primary constituents amylose and amylopectin, are traits of the species. Numerous starches are known to have therapeutic uses. These consist of potatoes (Olanumtuberosum), rice (Oryza sativa), wheat (Triticumaestivum), and maize (Zea mays). Protein and proteinase inhibitor-containing microcapsules have been created for the oral administration of peptidic and protein medications. Terephthaloyl chloride interfacial cross-linking was used to create mixed-wall starch/bovine serum albumin microcapsules. Protease inhibitors were added to the aqueous phase during the cross-linking process to load native or amino-protected aprotinin into microcapsules.

Polycaprolactone[42]-

A biodegradable polyester, polycaprolactone (PCL) has a low melting point of around 60°C and a glass transition temperature of about -60°C. Using a catalyst like stannous octoate, ε-caprolactone undergoes ring-opening polymerisation to create PCL. Speciality polyurethanes are the most prevalent application for polycaprolactone. Polycaprolactone gives synthetic polyurethanes good resistance to water, oil, solvents, and chlorine.

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Polyorthoesters [43]-

Materials that can be polymerised at room temperature without producing condensation byproducts are the outcome of several generations of synthetic refining. These substances have hydrolytic bonds that are stable at bases but susceptible to acids, making them hydrophobic. They deteriorate due to surface erosion, and the use of basic or acidic adjuvants can regulate the pace of disintegration.

Table 2- list the coating conditions, parameters& its parameters

Factor	Conditions
Equipment	Erweka Coating Pan
Substrate	50 mg Erythromycin stearate tablets
Pan Charge	3.5 Kg
Dispersion solid content	15.0% (w/w)
Pan speed	14 rpm
Exhaust air temperature	40-42ºC
Bed Temperature	35-40ºC
Spray rate	50 g/min.
Coating time	160 min.

The current trend& scope of coating in pharmaceutical oral solid dosage forms-

Aqueous coating technology remains the first choice for coating oral solid dosage forms. This is true regardless of the purpose of the film coating application. Releasefilmcoatingfor conventional release film coating. The main reasons for its popularity are environmental regulations on the organic solvents used, recent advances in the formulation of water-based film coating materials, and significant improvements made to coating machines and their accessories. Aqueous coating systems are widely used in conventional (immediaterelease) film coating systems, enteric coating (delayedrelease) film coating systems, and controlled release (delayed release) barrier membrane film coating systems. Compared to using individual ingredients, Opadry formulations offer fewer ingredients for QC testing, shorter dispersion preparation times, consistent color-matching formulations, better processability, and better tablet appearance.increase.They offered many advantages such as excellent mechanical film properties [55].

Opadry formulations have been widely used and successful worldwide and are still used in a variety of commercial products. A drawback of the Opadry formulation, however, is that the dispersed solids must be maintained in the range of 10-15% by weight in water to achieve a practical dispersed viscosity of 300-600 centipoise. His Opadry II product family, containing HPMC and polysaccharides, was introduced in the 1980s to improve productivity by reducing coating times and/or increasing spray rates. With opadry II, processable dispersions can be obtained at 20% solids instead of 10%-15% solids, enabling both increased productivity and improved adhesion. The most significant recent advancement in the development of fully formulated aqueous film coatings is the introduction of new film coatings based on polyvinyl alcohol (PVA) and sodium carboxymethyl cellulose (NaCMC) [56].

Film coatings containing these polymers provide formulators with comparable or better manufacturing facilities than when using Opadry formulations containing hydroxypropoxymethyl cellulose (HPMC), as well as previously unrealized capabilities. increase. PVA-based films are known to have relatively low water vapor and oxygen permeability.

On the other hand, NaCMC-based films have low oxygen permeability but relatively high water vapor permeability. Another important feature of NaCMC-based films is that they are highly glossy when properly formulated and applied. Therefore, NaCMC-based film coatings offer the potential to improve functionality and aesthetics [57].

Opadry's Aqueous Moisture Barrier (AMB) and Opadry II series are two proprietary PVA-based product families launched in the mid to late 1990's. Opadry AMB formulations have been optimized to provide the lowest possible Moisture Vapor Transmission Rate (MVTR) while providing all the benefits of a fully formulated film coating system. Offered as a color-matching system, it is 20% solids and easily dispersible in water [58].

Due to the inherent tackiness of the PVA polymer, the maximum spray rate achievable with Opadry AMB is not as high as his HPMC-based Opadry II film coating. The Opadry II series product family was developed to address this issue.

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The Opadry II series products offer about the same low MVTR as the Opadry AMB, but can be applied at significantly higher spray speeds.

Film coatings based on PVA and NaCMC offer formulators new functional advantages. It is now possible to coat moisture-sensitive cores with an aqueous coating process, use PVA-based coatings to preserve them. NaCMC-based coatings have demonstrable oxygen barrier properties, and excellent aesthetic properties provide [59].

Extended-release coating

In large companies, product batches were large enough to justify the use of pan coating: thousands of pills or tablets could be coated economically with a relatively small number of workers. presentday. The era of pharmaceutical coatings has begun. During the first half of this century, tablet coating evolved into the process we know today. Glazebread has changed very little in the last 100 years. Copper pots, a remnant from confectionery, were replacedby stainless steel [67].

Dry air sources evolved from charcoal to steam and eventually to the hot air systems used today. Finally, the coater outlet was replaced with a spray nozzle for better control over the application of the coating solution. The technique of sugar coating had reached near perfection by his early 1950s, but its shortcomings overshadowed a more efficient and versatile technique. The introduction of film coating in the pharmaceutical industry (Abbott Laboratories, 1953) brought about a major shift in prescribers' perception of tablets [68].

New polymer coatings allow tablets to take on a variety of shapes, so we are no longer restricted to using shapeless, roughly spherical tablets. Embossed tablets can also be coated efficiently and aesthetically. Although these new coatings are versatile, they are not well suited for use on existing coating equipment. His two advances in coating technology were introduced almost simultaneously with the development of his new polymer his coating. Both have become essential to the modern pharmaceutical industry [69].

Adding many small holes and including them in a sealed cabinet was a modification of the traditional plating his pan, resulting in a "perforated" pan. Perforated trays (such as Thomas Engineering's Accela Coater) allow large volumes of air to flow through the tablet bed and control the temperature required to meet the polymer film coating requirements. The second of these innovations, the air suspension coater, was an entirely different approach to coating. Unlike the coating pan, the suspension coater is a mechanism that continuously moves the tablets up and down in an air stream while spraying the coating liquid from below.

Since its inception, the fluid bed coater has been continuously improved to become a highly versatile tool capable of coating tablets, pellets, and even very small granules in a timely manner. Many things are possible, but perhaps the greatest advantage of this device is its ability to operate in a closed-loop mode, which facilitates the recovery of organic solvents and increases the level of occupational and environmental safety [70].

Further advances in coating technology were not of great magnitude, but they did help improve existing technology. Finally, the most commonly used coating machines and processes performed in the industry today Suitable are for coating types. Likewise, advances in coating machinery are likely to accompany or follow the development of new types of coatings. Unfortunately, it's time for cost containment and conservative prescribing strategies [71].

Features of the coating process-

Development of the coating process The concept of coating was developed in ancient times. First, Rhazes used psyllium to mask the taste of the pills. It was later reported that Avicenna coated the tablets with silver and gold. At that time, various materials were used for coatings. Talc, known as Pearl He Coating, was introduced by White used to coat tablets. In 1838 Garot introduced a method of coating tablets with gelatin [69].

The poisoned tablets were coated with wax to prevent accidental poisoning. Previously, only dragees were made for instant prescriptions by pharmacy workers. The practice then took off in the pharmaceutical industry and large-scale production began.In 1842, the first sugar-coated (SC) tablets were imported from France into the United States (USA). In 1856, a Philadelphia pharmacist created a native-coated pill. Until 1950, SC was considered a coating-purpose technology with a lot of work to do [70].

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Table 4- Representing drawbacks of FC

Flaw	Definition	Treatment	
Blistering	Blistering is the separation of film from the surface of an object (such as a tablet) that results in the formation of blisters.	That defect could be treated by designing the drying conditions to be mild	[72]
Chipping	Chipping states a condition where the film becomes dented, chipped from the edges.	The operator must exercise caution during the pre-heating stage to avoid over-drying the tablets. Otherwise, the brittleness of the tablets promotes the defect.	[73]
Picking	It is defined as the adhered film on the tablet's surface that may be torn away, resulting in the sticking of tablets	The condition may be treated by reducing the volume of applied liquid or by increasing the temperature of dry air.	[74]
Pitting	In this type of defect, specific pits have appeared on the surface of the dosage form without any visual disappearance of the FC	Adjusting the temperature during the process of tablet core results in the removal of such defects.	[75]
Roughness /Orange peel	It is a surface defect in which the film appeared to be non-glossy and resembled an orange	The problem may be corrected by an additional solvent which causes the thinning of the solution	[76]

II. CONCLUSION

It turns out that tablets are the most common and oldest dosage form. In front of the. The invention of machinery made it possible to manufacture tablets by hand. This is intended to prevent unpleasant taste masking of various active ingredients. It is finished to protect against atmospheric conditions and the harsh stomach environment. Various coating techniques have been used to coat dosage forms. Additionally, each coating technique has advantages and disadvantages. FC is an important but general process that provides different functionalities to dosage forms, thereby meeting different therapeutic needs. The coating improves product quality. The coating perfectly applies to already used dosage forms. Coatings control drug bioavailability. In addition, various defects can appear during painting. Errors reduce user acceptance and product efficiency. In this review, we have discussed the drawbacks of coatings, the factors that influence the types of coatings and different coating methods, and the advantages and disadvantages of coatings. Great potential for future development of the domain-specific advantages of tablet coatings.

CONFLICTS OF INTEREST

There are no conflicts of interest and disclosures regarding the manuscript.

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