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# A REVIEW ON ENTERIC COATED TABLET

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## ABSTRACT

The blessings of tablet coating are flavour covering, smell overlaying, bodily and chemical protection, protects the drug from the gastric surroundings and so on.Enteric coated tablets are solid unit dosage forms which are designed to bypass the stomach and release the drug in small intestine and are meant for oral administration. The word "enteric" indicates small intestine; therefore enteric coatings prevent release of medication before it reaches the small intestine.Most enteric coating works by presenting a surface that is stable at the highly acidic pH found in stomach, but breaks down rapidly at a less acidic pH. For e.g. they will not dissolve in the acidic juices of the stomach (pH-3), but will in the alkaline (pH7-9) environment present in the small intestine. Materials used for enteric coatings include CAP, CAT, PVAP and HPMCP, fatty acids, waxes, shellac, plastics and plant fibres.

**KEYWORD**: Enteric coated tablet, Intestine, Acidic pH, Materials used.

## INTRODUCTION

Tablet is a pharmaceutical solid dosage form, comprising a mixture of active substances and excipients, commonly in powder form, pressed or compacted right into a stable. Coating is a process by which an essentially dry, outer layer of coating material is applied to the surface of a dosage form in order to confer specific benefits that broadly ranges from facilitating product identification to modifying drug release from the dosage form. An enteric coating is a barrier that controls the location of oral medication in the digestive system where it is absorbed. The word "enteric" indicates small intestine; therefore enteric coatings prevent release of medication before it reaches the small intestine. The enteric coated polymers remain unionise at low pH, and therefore remain insoluble. But as the pH increases in the

GIT, the acidic functional groups are capable of ionisation, and the polymer swells or becomes soluble in the intestinal fluid. Materials used for enteric coatings include CAP, CAT, PVAP and HPMCP, fatty acids, waxes, shellac, plastics and plant fibers.[1]

## EXAMPLE

**Sulfasalazine** is a drug which used for the treatment of arthritis and it was also used for the treatment of crohn's disease. Crohn's disease is a chronic disease that affects the intestines. When used for arthritis, it get absorbed more quickly because it was given without an enteric coating. Enteric coating has to be given to the medications which are used for the treatment of crohn's disease because it has to work in the intestines.[6]

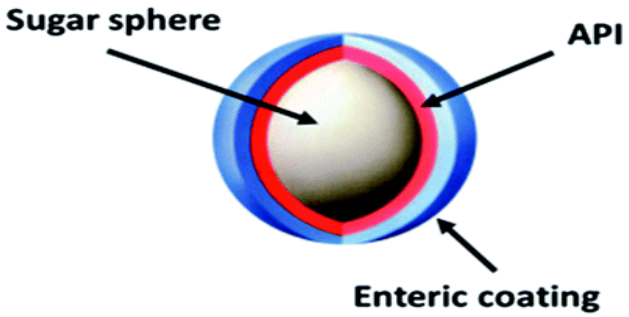


**Figure 1: Enteric coating.**

## IDEAL PROPERTIES OF ENTERIC COATING

- Resistance to gastric fluids
- Susceptible/permeable to intestinal fluid
- Compatibility with most coating solution components and the drug substrate
- Formation of continuous film
- Nontoxic, cheap and ease of application
- Ability to be readily printed

## POLYMERS USED IN ENTERIC COATING

**Table 1: Polymers used in enteric coating.**

| Polymers | Dissolution pH |
|---|---|
| Shellac (esters of aleurtic acid) | 7.0 |
| Cellulose acetate phthalate (CAP) | 6.2 |
| Poly(methacrylic acid-co-methyl methacrylate) | 5.5-7.0 |
| Cellulose acetate trimellitate (CAT) | 5.0 |
| Poly(vinyl acetate phthalate) (PVAP) | 5.0 |
| Hydroxypropyl methylcellulose phthalate(HPMCP) | 4.5-5.5 |

## ADVANTAGES OF ENTERIC COATING

- To protect the drug from the stomach
- To protect the acid liable drugs from the gastric fluid e. g. enzymes and certain antibiotics
- Coatings can also facilitate printing on tablets, if required. Coatings are necessary for tablets that have an unpleasant taste, and a smoother finish makes large tablets easier to swallow.[3]
- To forbid gastric distress or nausea due to irritation from a drug, e.g. sodium salicylate.[6]
- To deliver drugs intended for local action in the intestines, e. g. intestinal antiseptics could be delivered to their site of action in a concentrated form.[6]

## DISADVANTAGE

- This process is tedious and time-consuming and it requires the expertise of highly skilled technician.[6]

## COMPOSITION OF ENTERIC COATING

An enteric coating composition including about 0.01% - 10% resin and about 0.01% - 10% polymer. The enteric coating composition may be applied to a substrate, such as pharmaceutical, neutraceutical, fruit, vegetable, agriculture or industrial product to form an enteric coating on the substrate A resin- e.g.- shellac, A polymer-e.g – alginate, A plasticizer- e.g.-tri ethyl citrate, A preservative- e.g.- sorbates, A detackifying agent- e.g.- monosterate, A lubricant- e. g.-palmitic acid, A colorant- e.g.- FD & C lake yellow no 5, A flavor- e. g.- blue berry, butterscotch, A sweetener- e.g.- sucrose, honey, A taste maskant- e.g.- carboxy methyl cellulose, An opacifier- e.g.- titanium dioxide, A buffering agent- e.g.- sodium citrate, An antioxidant- e.g.- tocopherol, A solvent- e.g.- ethanol, water and combinants therefore.[6]

## COATING PROCESS[10,11]

1. Tablet coating takes place in a controlled atmosphere inside a perforated rotating drum. Once you load a batch of tablets into the coating pan, you need to preheat the tablets and allow time for dust and tablet flash to exit the pan. Angled baffles fitted into the drum and air flow inside the drum provide means of mixing the tablet bed. As a result, the tablets are lifted and turned from the sides into the centre of the drum, exposing each tablet surface to an even amount of deposited/sprayed coating. Once the temperature of the outlet air reaches 42° to 46°C, usually within 15 minutes, spraying can begin.

2. The spray guns create a fine mist of coating solution that dries just after it contacts the tablet. The liquid spray coating dried onto the tablets by heated air drawn through the tablet

bed from an inlet fan. The air flow is regulated for temperature and volume to provide controlled drying and extracting rates, and at the same time, maintaining the drum pressure slightly negative relative to the room in order to provide a completely isolated process atmosphere for the operator.

3. As the water evaporates, it leaves the solids behind to form a thin film on the tablet. The key to tablet coating is to get the surface slightly wet and immediately dry. Remember: apply the coating in many short, fast exposures, not in long, slow exposures.

4. Once the base coating is applied, you can increase the rate of solution addition and the pan speed proportionately. Typically, it takes about 20 minutes before increasing the spray rate and pan speed significantly.

5. Tablets that are very porous may require an initial spray rate that is slower than the average of 100 millilitres per minute per gun. Be sure to monitor spraying to see whether the spray pattern changes. If it does, there is likely a build-up of solids on the gun tips. Correct this only by cleaning the tips, which means stopping the spray and the pan.

6. The enteric coating solution dries on the tablet surface because there is a constant supply of hot air entering the drum and passing through the drum perforations into the bed of tablets. Over time, the film builds layer after layer of solids.

7. After finished applying the solution and drying it, the tablets must cool. For coatings to adhere properly, the tablets must remain at a specific temperature, the solution must be applied at a consistent rate, and the motion of the tablets must be active yet tranquil. Disrupt any of these conditions, and this will produce a defective tablet.

**Mechanism of Enteric Coated Time-Release Press Coated (Etp) Tablets**

ETP tablets are composed of three layers, a drug containing core tablet (rapid release function), the press coated swellable hydrophobic polymer layer (Hydroxy propyl cellulose layer (HPC), time release function) and an enteric coating layer (acid resistance function).[12,13] The tablet does not release the drug in the stomach due to the acid resistance of the outer enteric coating layer. The enteric coating layer rapidly dissolves after gastric emptying and the intestinal fluid begins to slowly erode the press coated polymer (HPC) layer. Rapid drug release occurs when the erosion front reaches the core tablet since the erosion process takes a long time as there is no drug release period (lag phase) after gastric emptying. The duration of lag phase (drug release period) is controlled either by the weight or composition of the polymer (HPC) layer.

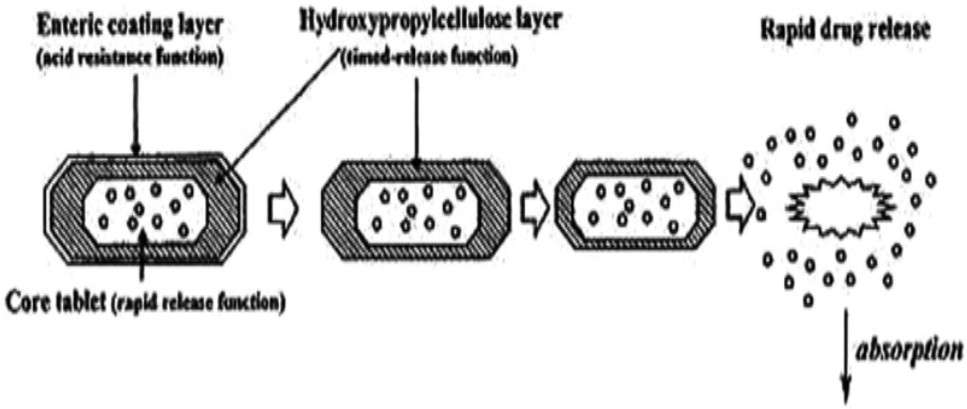


**Figure 2: Design of enteric coated timed-release press coated tablet (etp tablet).**

**Method of Manufacturing Enteric Coated Tablet By Spray Coating Technique[8]**

**1 Preparation of core tablets**

Granules were prepared using wet granulation method. Drug and other excipients were passed through # 80 and add sufficient quantity of binding agent slowly to get dough mass. The mass was sieved through # 8 and dried at 45ºC for about 1 hrs. and then these granules were passed through # 20 and lubricated with magnesium stearate. Mixed blend was compressed into tablets on single punch tablet compression machine to a weight of 250 mg each with thickness of 4.46 ± 0.21 mm and diameter of 7.9 mm using shallow concave plain/plain punch.

**2 Coating of core tablets**

Preparation of enteric coating solution Weighed amount of pectin was dissolved in 50 ml of water and ethyl cellulose was dissolved in 50 ml of isopropyl alcohol. The two solutions were then mixed well to form a homogeneous solution and PEG-6000 was added as a plasticizer.

**3 Coating of core tablets**

Enteric coating of the compressed tablets is achieved by standard coating pan technique. Tablets were taken and were coated in a pan coater at 50 rpm at a temperature of 50ºC and at a flow rate of 10 ml/min. Coating was carried out with spraying method and dried. These solutions are applied over tablets using spray gun at appropriate pressure. The coated tablets are primarily dried using heat blower and secondarily dried in tray drier.

**4 Coating methodology[14]**

Tablet coating was performed in a conventional coating pan with one spray gun. The coating pan was previously cleaned using alcohol 95%. A batch size of 3.5 kg core tablets was

selected for coating. The core tablets were loaded into the coating pan. Tablet cores were pre-heated to about 40°C utilizing a dryer and air compressor. Warm air was introduced into the coating pan (up to 50–55°C) during the entire coating process. The spray gun was filled with enteric coating solution and operated at a proper flow rate. The pan was set into motion and seal coating dispersion was sprayed on to the falling cores under a suitable air pressure (87.0-116.0 psi) 6-8 bar. The air heater was switched off and tablets were blow dried for 20-25 minutes in the coating pan. The core tablets gained 10 ± 2% weights after coating with enteric coating solution.

## MANUFACTURING DEFECTS OF TABLETS


**Figure 3: Defects in tablet.**

## 1-THE DEFECTS RELATED TO TABLETTING PROCESS

### 1.1-CAPPING

'Capping' is the term used, when the upper or lower segment of the tablet separates horizontally, either partially or completely from the main body of a tablet and comes off as a cap, during ejection from the tablet press, or during subsequent handling.

Reason: Capping is usually due to the air–entrapment in a compact during compression, and subsequent expansion of tablet on ejection of a tablet from a die.[15-16]

The Causes and Remedies of Capping Related To Formulation (Granulation)

**Causes**

I. Large amount of fines in the granulation

II. Too dry or very low moisture content (leading to loss of proper binding action).

III. Not thoroughly dried granules.

IV. Insufficient amount of binder or improper binder.

V. Insufficient or improper lubricant.

VI. Granular mass too cold.

**Remedies**

I. Remove some or all fines through 100 to 200 mesh screen.

II. Moisten the granules suitably. Add hygroscopic substance e.g.: sorbitol, methyl- cellulose or PEG-4000.

III. Dry the granules properly.

IV. Increasing the amount of binder.

V. Adding dry binder such as pre-gelatinized starch, gum acacia, powdered sorbitol, PVP, hydrophilic silica or powdered sugar.

VI. Increase the amount of lubricant or change the type of lubricant.

VII. Compress at room temperature.

The Causes and Remedies Of Capping Related To Machine (Dies, Punches And Tablet Press)

**Causes**

I. Poorly finished dies.

II. Deep concave punches or beveled-edge faces of punches.

III. Lower punch remains below the face of die during ejection.

IV. Incorrect adjustment of sweep-off blade.

V. High turret speed

**Remedies**

I. Polish dies properly. Investigate other steels or other materials.

II. Use flat punches.

III. Make proper setting of lower punch during ejection.

IV. Adjust sweep-off blade correctly to facilitate proper ejection.

V. Reduce speed of turret (Increase dwell time)

**1.2-LAMINATION**

'Lamination' is the separation of a tablet into two or more distinct horizontal layers.

Reason: Air–entrapment during compression and subsequent release on ejection.

The condition is exaggerated by higher speed of turret.

The Causes and Remedies of Lamination Related To Formulation (Granulation)

**Causes**

I. Oily or waxy materials in granules.

II. Too much of hydrophobic lubricant.

III. Magnesium-stearate.

**Remedies**

I. Modify mixing process. Add adsorbent or absorbent.

II. Use a less amount of lubricant or change the type of lubricant.

The Causes And Remedies Of Lamination Related To 'Machine' (Dies, Punches And Tablet Press)

**Causes**

I. Rapid relaxation of the peripheral regions of a tablet, on ejection from a die.

II. Rapid decompression.

**Remedies**

I. Use tapered dies, i.e. upper part of the die bore has an outward taper of 3° to 5°.

II. Use pre-compression step. Reduce turret speed and reduce the final compression pressure.

## 2-DEFECTS RELATED TO EXCIPIENT

### 2.1-CHIPPING

'Chipping' is defined as the breaking of tablet edges, while the tablet leaves the press or during subsequent handling and coating operations.

Reason: Incorrect machine settings, specially mis-set ejection take-off.[15]

The Causes And Remedies Of Chipping Related To Formulation (Granulation)

**Causes**

I. Sticking on punch faces

II. Too dry granules.

III. Too much binding causes chipping at bottom.

**Remedies**

I. Dry the granules properly or increase lubrication.

II. Moisten the granules to plasticize. Add hygroscopic substances. Optimize binding, or use dry binders.

The Causes and Remedies of Chipping Related To 'Machine' (Dies, Punches And Tablet Press).

**Causes**

I. Groove of die worn at compression point.

II. Barreled die (center of the die wider than ends)

III. Edge of punch face turned inside/inward.

IV. Concavity too deep to compress properly.

**Remedies**

I. Polish to open end, reverse or replace the die.

II. Polish the die to make it cylindrical.

III. Polish the punch edges.

IV. Reduce concavity of punch faces. Use flat punches.

**2.2-STICKING**

'Sticking' refers to the tablet material adhering to the die wall.

Filming is a slow form of sticking and is largely due to excess moisture in the granulation.

Reason: Improperly dried or improperly lubricated granules.[17]

The Causes And Remedies Of Sticking Related To Formulation (Granulation)

**Causes**

I. Granules not dried properly.

II. Too little or improper lubrication.

III. Too much binder.

IV. Hygroscopic granular material.

V. Oily or way materials.

VI. Too soft or weak granules.

**Remedies**

I. Dry the granules properly. Make moisture analysis to determine limits.

II. Increase or change lubricant.

III. Reduce the amount of binder or use a different type of binder.

IV. Modify granulation and compress under controlled humidity.

V. Modify mixing process. Add an absorbent.

VI. Optimize the amount of binder and granulation technique.

The Causes And Remedies Of Sticking Related To Machine (Dies, Punches And Tablet Press)

**Causes**

I. Concavity too deep for granulation.

II. Too little pressure.

III. Compressing too fast.

**Remedies**

I. Reduce concavity to optimum.

II. Increase pressure.

III. Reduce speed.

**2.3-PICKING**

'Picking' is the term used when a small amount of material from a tablet is sticking to and being removed off from the tablet-surface by a punch face.

The problem is more prevalent on the upper punch faces than on the lower ones. The problem worsens, if tablets are repeatedly manufactured in this station of tooling because of the more and more material getting added to the already stuck material on the punch face.

Reason: Picking is of particular concern when punch tips have engraving or embossing letters, as well as the granular material is improperly dried.[17]

The Causes and Remedies of Picking Related To Formulation (Granulation),

**Causes**

I. Excessive moisture in granules.

II. Too little or improper lubrication.

III. Low melting point substances, may soften from the heat of compression and lead to picking.

IV. Low melting point medicament in high concentration.

V. Too warm granules when compressing.

VI. Too much amount of binder.

**Remedies**

I. Dry properly the granules, determine optimum limit.

II. Increase lubrication; use colloidal silica as a 'polishing agent', so that material does not cling to punch faces.

III. Add high melting-point materials. Use high meting point lubricants.

IV. Refrigerate granules and the entire tablet press.

V. Compress at room temperature. Cool sufficiently before compression.

VI. Reduce the amount of binder, change the type or use dry binders.

The Causes and Remedies Of Picking Related To Machine (Dies, Punches And Tablet Press).

**Causes**

I. Rough or scratched punch faces.

II. Bevels or dividing lines too deep.

III. Pressure applied is not enough; too soft tablets.

**Remedies**

I. Polish faces to high luster.

II. Design lettering as large as possible.

III. Plate the punch faces with chromium to produce a smooth and non-adherent face.

IV. Reduce depths and sharpness.

V. Increase pressure to optimum.

**3-Defects Related To More Than One Factor**

**3.1-Mottling**

'Mottling' is the term used to describe an unequal distribution of colour on a tablet, with light or dark spots standing out in an otherwise uniform surface.

Reason: One cause of mottling may be a coloured drug, whose colour differs from the colour of excipients used for granulation of a tablet.[18]

The Causes And Remedies Of Mottling.

**Causes**

I. A coloured drug used along with colourless or white-coloured excipients.

II. A dye migrates to the surface of granulation while drying.

III. Improperly mixed dye, especially during 'Direct Compression'.

IV. Improper mixing of a coloured binder solution.

**Remedies**

I. Use appropriate colourants.

II. Change the solvent system, Change the binder, Reduce drying temperature and Use a smaller particle size.

III. Mix properly and reduce size if it is of a larger size to prevent segregation.

IV. Incorporate dry colour additive during powder blending step, then add fine powdered adhesives such as acacia and tragacanth and mix well and finally add granulating liquid.

**EVALUATION OF TABLET**

Following tests were applied on coated tablet.

**Appearance**

The general appearance and elegance of tablet was identified visually, which include tablet size, shape, color, presence or absence of an odour, surface texture etc.

**Weight variation**

Twenty tablets were weighed individually and average weight was determined. the individual tablet weight was compared with average tablet weight. the coated tablet weight and the maximum percent difference allowed is 5.0%.

**Thickness**

Tablet was selected at random from individual formulations and thickness was measured by using venire caliper scale, which permits accurate measurement. tablet thickness should be controlled within a ± 0.2% variation of standard value.

**Tablet Friability**

Friability is the measure of tablet strength. Roche Friabilator was used for testing the friability using the following procedure. Twenty tablets were weighed accurately and placed in the tumbling apparatus that revolves at 25 rpm dropping the tablets through a distance of six inches with each revolution. After 4 min, the tablets were weighed and the percentage loss

in tablet weight was determined.

% Loss = Initial wt. of tablet − Final wt. of tablet/ Initial wt. of tablet

**Hardness**

Tablet was selected at random from individual formulations and measured by using Erweka hardness tester.

**Disintegration test**

Disintegration time was determined using the disintegration apparatus USP in 0.1N HCl for 2 hrs. and then in phosphate buffer pH 6.8 for 1 hour maintaining the temperature at 37 ± 2°C. 7.5 Thickness.[9]

**Dissolution test**

The tablets were evaluated for in vitro drug release was carried out using USP dissolution.

**Apparatus**. The following conditions were applied.

**USP** Dissolution apparatus: Type II (Paddle)

**Media**: 0.1N HCl for two hours followed by 6.8 pH phosphate Buffer

**Volume** of dissolution media : 1000 Ml

**Speed** of paddle rotation : 100/50 RPM

**Temperature:** 37 ± 0.5°C

Six tablets were subjected to two hours exposure in 0.1N HCL buffer followed by immediate transfer to a dissolution bath containing 6.8 pH phosphate buffer and % drug released was measured. Buffer phase: - Samples were withdrawn from the dissolution vessels at 0, 60, 120, 135, 150, 165, 180 minutes interval. the % drug release was measured U.V method.

**CONCLUSION**

From the above review, we can conclude that tablets are made enteric-coated for avoiding the first pass metabolism, gastric irritation and degradation and to direct the drug to the target intestines. Enteric coating protect the stomach against drugs which causes gastric irritation. Enteric coating protect the drug which is unstable in gastric fluids. Enteric coating provide a delayed- release component for repeat action tablets. The choice of the polymer and the thickness of the coated layer are critical to control the pH solubility profile of the enteric coated dosage form. An ideal polymer should be selected depending upon the type of the dosage form. This dosage form is preferred as it is very convenient and easy to formulate,

cost-effective and does not require high cost equipments. For that reason, this dosage form has been gaining so much attention nowadays.

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