International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 11 Issue 7, July 2024, Impact Factor: 8.325

A Review on Enteric Coated Tablets

Miss. Vaishnavi Rajendra Jagtap[*1], Mr. Jitendra V. Shinde[2]

[1]Student, Pune District Education Association's Seth Govind Raghunath Sable College of Pharmacy, Saswad
[2]Head of Department of Pharmaceutics, Research Scholar, A.P.J. Abdul Kalam University Indore

Address of Correspondence: Miss. Vaishnavi Rajendra Jagtap, Saswad Pune 412301, Vaishnavij2104@gmail.com

ABSTRACT

Enteric-coated tablets are solid unit dosage forms that are designed to bypass the stomach and release the drug in the small intestine and are intended for oral administration. The word "enteric" refers to the small intestine; therefore, enteric coatings prevent drug release before it reaches the small intestine. Most enteric coatings work by presenting a coated surface that is stable at the highly acidic pH found in the stomach, but degrades rapidly at the less acidic (relatively more basic) pH. Materials used for enteric coatings include CAP, CAT, PVAP, and HPMCP, fatty acids, waxes, shellac, plastics, and plant fibers. This review describes enteric coatings, their ideal properties, advantages and limitations, the various polymers used, their chemical structure, drug selection criteria and mechanism, methods of production and evaluation of enteric tablets. Recently, they have attracted the interest of many formulators due to their advantages over conventional drug delivery systems as they extend dosing intervals and also increase patient compliance. The study provides an overview of recent advances in this arena.

Keywords: Enteric coated tablet, Evaluation, Ideal Properties, Mechanism and Methods of enteric coated tablets.

INTRODUCTION

A tablet is a pharmaceutical solid dosage form, containing a mixture of active substances and excipients, usually in powder form, pressed or pressed directly into the stable. Coating is a process in which a coating material is applied to the surface of a dosage form to impart specific benefits to the dosage form. The enteric coating is a barrier that controls the release of an oral drug in the stomach and promotes its release in the intestine where it is absorbed. The word "enteric" refers to the small intestine; therefore, enteric coatings prevent drug release before this reaches the small intestine. Enteric coated polymers remain non-ionized at low pH and therefore remain insoluble. But as the pH in the GIT increases, the acidic functional groups are able to ionize 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] Enteric coating covers various ideal properties such as resistance to gastric fluids, sensitive/permeable to intestinal fluids, compatibility with most components of coating solution and drug substrate, continuous film formation, non-toxic, cheap and easy to apply. Various polymers used in enteric coatings are shellac (aluretic acid esters), cellulose acetate phthalate (CAP), poly (methacrylic acid-co-methyl methacrylate), cellulose acetate trimellitate (CAT), poly(vinyl acetate phthalate) (PVAP), and hydroxypropyl methylcellulose phthalate (HPMCP). Polymers were selected based on dissolution pH in the range of 4.5 – 7.0.[2]

Tablet Coating:
Coating is a process in which a substantially dry outer layer of coating material is applied to the surface of a dosage form to provide specific benefits that range widely from facilitating product identification to modifying drug release from the dosage form. After making a good tablet, it is necessary to coat it often.[3-5]

The coating can be applied to several different oral solid dosage forms, including tablets, capsules, multiparticulates and drug crystals. When the coating agent is applied to a batch of tablets in the coating pan, the surfaces of the tablets are coated with an adhesive polymer film. Before the tablet surface dries, the applied coating changes from a sticky liquid to a sticky semi-solid and eventually to a non-sticky dry surface. The entire coating process is carried out in a series of mechanically controlled acorn-shaped coating pans of galvanized iron, stainless steel or copper. Smaller pans are used for experimental, development and pilot-scale operations, larger pans for industrial production.[4-5]

Primary components involved in tablet coating:

- Tablet properties

- Coating process
- Coating equipments
- Parameters of the coating process
- Facility and ancillary equipments
- Automation in coating processes.[4-5]

Coating process design and control:
In most coating methods, when the tablets are mixed in a pan, fluidized bed, etc., the coating solution is sprayed onto the tablets at this point. As the solution is sprayed, a thin film is formed that adheres directly to each tablet. The coating can be created either in a single application or can be created in layers using multiple spray cycles.[2]

Rotary coating pans are often used in the pharmaceutical industry. First, the uncoated tablets are placed in a pan, which is typically inclined at an angle from the horizontal plane, and then a liquid coating solution is introduced into the pan while the tablets are rolled. Passing air over the surface of the inverting tablets then evaporates the liquid portion of the coating solution. In contrast, a fluidized bed coater operates by passing air through a bed of tablets at a rate sufficient to support and separate the tablets as individual units. Once separation occurs, the tablets are sprayed with a coating agent [3-9]

NECESSARY COATING

1. After taking a typical supplement:
The tablet is swallowed and travels through the esophagus to the stomach. In the stomach, the tablet shakes and swirls in a highly acidic environment digestive secretions with pH (1-4), for 45 minutes to 2 hours. If there is anything left from the tablet, it passes through the duodenum into the small intestine.

2. Fate of uncoated tablets:
Stomach acid breaks down the tablets to prematurely release the active substances (enzyme). The highly acidic environment of the stomach destroys most enzyme activities. If the tablet is of poor quality (contains binders and fillers), the product may pass through the stomach and intestines without absorption.

The primary ingredient involved in the formulation of enteric-coated tablets-

• Tablet core production:
• Coating composition:
a) Polymers.
b) Plasticizer.
c) Solvent.
d) Dye.

• **Coating process**
A) Coating equipment
a) Coating pan.
b) Spray system.
e) Air handling system.
d) Dust collector.
e) Process parameter.

The composition of the enteric coating
The enteric coating tablet composition contains about 0.01% to 10% resin and about 0.01% to 10% polymer. The enteric coating composition can be a pharmaceutical, nutraceutical, fruit, vegetable, agricultural or industrial product to form an enteric coating on a substrate.[10]

Additives	**Example**
Resin	Shellac
Polymer	Alginate
Plastisizer	Triethylcitrate
Preservative	Sorbates
Detackifying agent	Monosterate
Lubricant	Palmiticacid
Colorant	FD & Clake yellow

Ideal properties of an enteric coating material:

- Resistance to gastric fluids
- Sensitive/permeable to intestinal fluids
- Compatibility with most coating solution components and drug substrate
- Creating a continuous film
- Nontoxic, cheap and ease of application
- Ability to be readily printed [5-7]

Polymers used for enteric coating Polymers	DissolutionpH
Shellac	7.0
Celluloseacetatepthalate	6.2
Poly(methacrylic-co-methylMethacrylate	5.5-7.70
Celluloseacetatetrimellitate	5.0
Poly(vinylacetatepthalate)	5.0
Hydroxypropylmethylcellulosepthalate(HPMCP)	4.5-5.5
Hypromelloseacetatesuccinate	>5.5
Hypromellosephthalate	>5.5
EudragitL100-55	>5.5
EudragitL30D-55	>5.5
EudragitL100	>6.0
EudragitL12,5	>6.0
EudragitS-100	>7.0
EudragitS12,5	>7.0
EudragitFS30D	>7.0
Hydroxyl propylethylcelluloseptha late	>4.5

Coating process [11-12]:

Tablet coating takes place in a controlled atmosphere inside a perforated rotary drum. Once the batch of tablets has been placed in the coating pan, preheat the tablets and allow time for the dust and tablet to leave the pan. Angled baffles mounted in the drum and air flow inside the drum provide a means of mixing the tablet bed. As a result, the tablets are lifted and rotated from the sides to the center of the drum, exposing each surface of the tablet to an even amount of applied/sprayed coating. Once the outlet air temperature reaches 42°C to 46°C, usually within 15 minutes, spraying can begin. The spray gun creates a fine mist of coating solution that dries immediately upon contact with the tablet.

The liquid spray coating was dried onto the tablets by heated air drawn through the tablet bed from an inlet fan. Air flow is temperature and volume regulated to provide a controlled rate of drying and extraction while maintaining drum pressure slightly negative relative to the room to provide a completely isolated process atmosphere for the operator. As the water evaporates, it leaves behind solid particles and forms a thin film on the tablet. The key to coating tablets is to slightly moisten the surface and dry immediately. Apply the coating in many short, fast exposures, not in long, slow exposures. Once the primer is applied, you can proportionally increase the rate of addition of the solution and the speed of rotation. It usually takes about 20 minutes for the spray rate and pan speed to increase significantly.

Tablets that are very porous may require an initial spray rate that is less than the average of 100 milliliters per minute per gun. Be sure to monitor the spray to see if the spray pattern changes. If so, solids have probably built up on the tips of the gun. Only fix this by cleaning the tips, which means stopping the spray and the pan. The enteric coating solution dries on the surface of the tablet as a constant supply of hot air enters the drum and passes through the perforations of the drum into the tablet bed. Over time, the film builds up layer upon layer of solids. After the application of the solution is completed and its drying, the tablets must cool down. For the coatings to adhere properly, the tablets must remain at a certain temperature, the solution must be applied at a constant rate, and the movement of the tablets must be active yet still. Disrupt any of these conditions and it will result in a defective tablet.

Mechanism of enteric tablets:

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

Methods used in the production of tablets:

A) Direct compression:

Direct compression is defined as a process in which tablets are compressed directly from a powder mixture of API and suitable excipients. No pretreatment of the powder mixture by wet or dry granulation is required. The advantage of direct compression is the savings in energy, equipment, material and handling costs. The disadvantage is segregation problem, content uniformity problem and dust generation.

B) Wet Granulation Process:

wet granulation. Wet granulation process simply in volves wet massing of the powder blend with a granulating liquid, wetsizing and drying.

Important steps involved in wet granulation

i) Mixing the drug(s) and excipients.

ii) Preparation of binder solution.

iii) Mixing the binder solution with the powder mixture to form a wet mass. wet granules. Mixing screened granules with disintegrant, lubricant and lubricant.

Latest trends in tablet coating techniques Electrostatic dry coating:

The electrostatic dry powder coating process for tablets was developed for the first time by electrostatic dry powder coating in a pan coating system. The optimized dry powder coating process produces tablets with a smooth surface, good coating uniformity and a release profile comparable to tablet cores. This new electrostatic dry powder coating technique is an alternative to the water or solvent based coating process for pharmaceutical products.[14]

The electrostatic coating process is widely useful in food technology, coating technology, metal coating, living cell coating, and tablet and capsule coating. The principle of electrostatic powder coating is to spray a mixture of finely ground particles and polymers onto the surface of a substrate without the use of a solvent and then heat the substrate to cure in an oven until the powder mixture melts into a film [15].

Magnetically Assisted Impaction Coating (MAIC):

A technique is developed to estimate the coating time in a magnetically assisted impact coating (MAIC) device. The mixture of host, guest and magnetic particles is assumed to remain in a fluidized state where the velocity distribution is of the Maxwell-Boltzman type. The collisions that occur between the particles are believed to be important for the impact of the guest particles on the surface of the host particles and thus the formation of a semi-permanent coating on the surface of the host particles. The application time depends on several parameters, including the number density host particles, the ratio of the host and guest particle diameters, the height of the fluidized bed of particles, and the material properties of the host and guest particles. There is an optimal bed height value for which the coating time is minimal. The coating time increases sharply, the bed height is smaller and larger than the optimal value, and also when the diameter of the host particles increases.[16]

Various dry coating methods have been developed, such as compression coating, plasticizer dry coating, heat coating, and electrostatic coating. These methods generally allow the application of high shear stresses or high impact forces or exposure to higher temperature for coating. Strong mechanical forces and the accompanying generated heat can cause layering and uniform deposition of the guest particles on the surface of the host particles. Many food and pharmaceutical ingredients, which are organic and relatively very soft, are very sensitive to heat and can be very easily deformed by strong mechanical forces. Therefore, some soft coating methods that can attach guest (coating material) particles to host (material to be coated) particles with minimal degradation of particle size, shape and composition due to heat build-up are the best candidates for such applications. . Magnetically Assisted Impact Coating (MAIC) devices can coat soft organic host and guest particles without changing the shape and size of the material. Although there is some heat generated at a minute level due to particle collisions during MAIC, it is negligible. This is another advantage when working with temperature-sensitive powders such as pharmaceuticals [15].

Magnetically Assisted Impact Coating (MAIC) is being developed to improve the mixing efficiency of powders with nanoparticles without the aid of solvent or heat. In general, uniform mixing of nanoscale.

3D printing:

3D printing is an innovative technology these days. It is also a cheap and easy method to incorporate a polymer to control drug release without using classical coating technologies such as coating pan or fluid bed. Extruder equipment can be used to prepare polymer filaments loaded with one or more drugs that are suitable for fused 3D printing. A 3D printer with more than one nozzle enables the fabrication of various solid devices, such as multilayer or coated devices. [17] As a result, it may be possible to use hot melt extrusion to incorporate coating polymers into filaments that can be used to print around 3D printed cores. [18]

Microencapsulation:
Microencapsulation enables the coating of particles (liquid, solid, semi-solid or gaseous) with polymeric coating materials. They can be made in several ways. The most common methodology is to induce coacervation or separation of macromolecules around the nuclei through a stimulus such as temperature change or solvent change, etc. Particles that are capable of forming a coating are dispersed in a solution of macromolecules and the stimulus is used to induce coacervation. The resulting coacervate droplets remain on the surface of the particles and form a coating. Finally, this layer needs to be treated so that it hardens.

Marketed Preparations of Enteric Coated Tablets:

Brandname	Genericname	Indication
Protonix	Pantoprazole	Heartburn, acidreflux
Aciphex	rabeprazole	Duodenalulcers
Pritosec	omeprazole	Refluxesophagitis
Nexium	esomeprazole	Erosiveesophagitis
Prevacid	lansoprazole	Indigestion, GORD
Endicer	Diclofenac	inflammation, arthritis
Ecosprin75	Aspirin	Chestpain
Deltacortil	Corticosteroid	Allergicreactions
Lipothiamine	Thiamine tetrahydrofurfutrl disulphide	Heartdisease
Green Tea+piperine	Polyphenols	Cellproliferation
Tru Niagen	Nicotinamideribo side	Rejuvenate cell production

Advantages of an enteric coating:
- Protect the medicine from the stomach
- Protect acid-sensitive medicines from gastric fluid, eg enzymes and some antibiotics
- Coatings are necessary for tablets that have an unpleasant taste, and the smoother surface makes it easier to swallow large tablets.[17]
- Prohibit stomach upset or nausea due to drug irritation, eg sodium salicylate.[18]
- Administer drugs intended for local action in the intestines, eg G. intestinal antiseptics could be delivered to the site of their action in a concentrated form.[19]

Disadvantages of enteric coating:
- Requires the expertise of a highly skilled technician.[20]
- This process is lengthy and time-consuming.[21]

Application of enteric coatings:
• Reduced GI toxicity
To overcome the adverse effects of Gl, an enteric formulation of sodium salt MPA was developed. (EC mycophenolate sodium or EC-MPS. Myfortic"). The commercial product is a hypromellose phthalate-coated delayed-release tablet. Pharmacokinetic studies in patients confirmed delayed-release and the time to peak MPA plasma concentration was 1.5-2.75 hours after oral administration MPS-later than after administration of MMF (T 0.5-1b).At standard doses, EC-MPS was able to consistently achieve an AUC >30 µg h/ml, which is likely the level required for efficacy. Both efficacy and side effects were reported to be similar for equivalent doses of MMF and EC-MPS (for the active mycophenolate moiety, 1000 mg of MMF is equivalent to 720 mg of MPS). Since pharmacokinetic analysis showed that EC-MPS achieved statistically higher plasma concentrations at equimolar doses and was not associated with an increase in adverse effects, EC-MPS may provide increased tolerability compared to systemic exposure and thus provide more patients with therapeutic concentrations. GI adverse effects after transplantation are difficult to quantify due to many confounding factors such as operative stress, data collection techniques, concomitant medications, and high prevalence of GI events even without MPA treatment. One study where patients were switched from MMF to EC-MPS showed a reduction in the severity of GI events for EC-MPS. Other reports have shown similar results after switching from MMF to MPS. In heart transplantation, there was a significant difference in MMF dose reduction of 42.1% versus MPS of 26.9% ($p<0.05$). Conflicting reports have been published for liver transplants. These authors concluded that it is beneficial to convert IMF to MPS.

• Targeting specific areas of the GI tract:
For some drugs, the targeted release of the active too small. the gut may offer therapeutic benefits. Cysteamine is one drug that has been reported to provide the highest exposure when targeted for release in the small intestine compared to the stomach or cecum. However, site-specific delivery to the proximal small intestine can be difficult due to the perceived slow dissolution of dosage forms in vivo once the enteric coating is broken down. Already in the 1970s, it was proposed to use effervescent preparations with an enteric coating for rapid disintegration in the proximal small intestine. intestine. The formulation of these drugs in an enteric product must be done carefully to ensure that the

dosage form is delivered intact from the stomach and then rapidly made available for absorption. One technique that has been recommended in these cases for good reproducibility and low inter-individual variability is enteric coating formulations no larger than 5 mm in diameter.

EVALUATION OF GRANULES:[22]

Measuring the angle of repose:
The pouring angle was determined by the funnel method. The determination of the angle of repose by this method is called the static angle of repose. The angle of repose is an indirect method of quantifying the flowability of a powder; because of their relationship to interparticle cohesion. A static pile moves when the angle of inclination is large enough to overcome the frictional forces and stops when the gravitational forces equalize the forces. The sides of the pile will make an angle with the horizontal called the angle of repose.[23] The powder is poured into the center of the bowl from a funnel that can be lifted vertically until the maximum height of the cone (h) is reached.

The angle of incidence can be calculated according to the given formulas.
$\alpha = \tan\text{-}1(h/r)$,
where h is the pile height and r is the pile radius. This was done three times, from this average inspiratory angle, and the standard deviation was calculated.

• Pore/bulk density:
The apparent true density (ρb) was measured by pouring a preweighed (M) mixture into a graduated cylinder. The volumetric volume (Vb) of the mixture was determined in this way. Then the actual density was determined according to the formulas below.
$\rho b = M/Vb$
This was done three times, from this average true density and the standard deviation was calculated.

• Tap density:
A measuring cylinder containing a known mass (M) of the mixture was tapped for a specified time and the minimum volume (Vt) occupied in the cylinder was measured. The density after shaking was calculated according to the formulas below.
Shock density = M/Vt
This was done three times, from this average shock density and the standard deviation was calculated.

• Porosity :[24]
The porosity of the voids and powder is defined as the ratio of the volume of the voids to the bulk volume of the package.
$E= (Vb - Vp)/Vb=1 - (Vp/Vb)$

EVALUATION OF CORE AND COATED TABLETS

Core and coated tablets were evaluated for hardness, friability, weight variation, disintegration time, thickness, drug content and in vitro release studies.

• Hardness:
Tablet compressive strength was measured using a Monsanto tablet hardness tester. A tablet is placed between the anvils and the compressive strength that causes the tablet to burst has been recorded.[25]

• Pettiness:
Tablet strength was tested using a Roche friabilator. Twenty tablets were accurately weighed and placed in the fribilator and operated at 100 rpm for 4 minutes. The tablets were dedusted and the percent weight loss was calculated by reweighing the tablets. Tablets that lost less than 1% weight were considered satisfactory.

• Changes in weight:[26]
Twenty tablets were randomly selected for weight variation and the average weight was determined using an electronic scale. The tablets were weighed individually and compared to the average weight.

• Decay time:[25]
Disintegration time was determined using a USP disintegration apparatus in 0.1N HCl for 2 hours. and then in phosphate buffer pH 6.8 for 1 h while maintaining the temperature at 37 ± 2 °C.

• Thickness:[26]
Tablet thickness was measured using a caliper.

• Drug content studies:[26]
Ten tablets were individually weighed and pulverized; an amount equivalent to 5 mg of the drug was taken and 50 ml of 95% ethanol was added and the mixture was shaken for 30 minutes. Sufficient ethanol (95%) was added to obtain 100 ml. It was centrifuged and an appropriate volume of supernatant equivalent to 0.5 mg of drug was pipetted off and diluted to 50 ml with 95% ethanol. The solution was filtered (over 0.45 µm). Drug content was measured at 236 nm using a UV/visible single beam spectrophotometer.

Defects related to closing the tableting process:
"Cap" is the term used when the upper or lower segment of the tablet separates horizontally, either partially or completely from the main body of the tablet and leaves as a cap, during ejection from the tablet press or during subsequent handling. Clogging is usually caused by entrapment of air in the compact during compaction, and subsequent expansion of the tablet as the tablet is ejected from the die.[27]

• Lamination:
"Lamination" is the division of a tablet into two or more distinct horizontal layers. The lamination is caused by the entrapment of air during compression and subsequent release during ejection. The condition is exacerbated by the higher turret speed.[28]

• Chopping:
"Chipping off" is defined as the breaking off of the edges of the tablet as the tablet leaves the press or during subsequent handling and coating. Splitting is caused by misalignment of the machine, specifically a misaligned ejection takeoff.[29]

• Bonding:
"Stick" refers to the tablet material adhering to the mold wall. Filming is a slow form of bonding and is largely caused by excess moisture in the granulation. Sticking occurs when improperly dried or improperly lubricated granules are used.[30]

• Collecting:
'Picking' is the term used when a small amount of tablet material adheres to the surface of the tablet and is removed by the punching surface. The problem is more prevalent on the upper sides of the punch than on the lower sides. The problem is exacerbated if the tablets are repeatedly produced in this machining station, as more and more material is added to the already bonded material on the face of the punch. Picking is especially important when the punch tips have engraved or embossed letters, as well as when the grain material is improperly dried.[31]

• Spotting:
"Mottled" is a term used to describe an uneven distribution of color on a tablet, with light or dark spots appearing on an otherwise uniform surface. One of the causes of mottling can be a colored drug, the color of which is different from the color of the excipients used to granulate the tablet.

LIMITATIONS

The reliability and efficiency of delivery is questionable due to the presence of a wide range of pH values and different enzymes present in the GI tract that drugs encounter before reaching the target site.[32]

OBJECTIVE

This study attempts to provide insight into gastro resistant drug delivery systems and in particular enteric coated tablets. Recently, they have attracted the interest of many formulators due to their advantages over conventional drug delivery systems. The study provides an overview of recent advances in this area.[33]

CONCLUSION

From the above overview, we can conclude that tablets are produced with an enteric coating to prevent first pass metabolism, gastric irritation and degradation and to direct the drug to the target intestines. The enteric coating protects the stomach from drugs that cause stomach irritation. The enteric coating protects the drug, which is unstable in gastric fluids. Tablet manufacturing defects include capping, lamination, chipping, tearing, and spotting. The enteric coated tablets were evaluated for hardness, weight variation, thickness, friability, appearance, dissolution test and disintegration test. This dosage form is advantageous because it is very convenient and easy to formulate, cost-effective and does not require high equipment costs. It is for this reason that this dosage form is gaining so much attention these days.

ACKNOWLEDGEMENT

Authors are highly thankful to Mr. Jitendra V. Shinde Head of Department of Pharmaceutics and for their support and encouragement and Department of Pharmacy, PDEA's SGRS College of Pharmacy, Saswad.

REFERENCES

[1]. Anil KP and Betty P, Colon Targeted Drug Delivery Systems: A Review on Primary and Novel Approaches, Oman Medical Journal, 2010;5(02):70-78.
[2]. Sing DH, Roychowdhury S, VermaP, BhandariV: A review on recent advances of enteric coating IOSR Journal of pharmacy, 2012;2:2250-3013.
[3]. Lachman L, Lieberman HA, Joseph LK. The Theory and Practice of Industrial Pharmacy. Varghese Publishing House; Mumbai; Third Edition: 297-321.
[4]. Lachman L, Liberman H, KanigJ. The Theory and Practice of Industrial Pharmacy; Third Edition: 293-345,346-373.
[5]. Aulton M. Pharmaceutics: The Science of Dosage Form Design. International StudentEdition:304-321,347-668
[6]. Vyas S, Khar R. Controlled Drug Delivery Concepts and Advances; FirstEdition:219-256.
[7]. Ansel H, Allen L, Jr. Popovich N. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems; Eighth Edition:227-259.
[8]. Remington J. Remington: The Science and Practice ofPharmacy;2(19):1615-1641.
[9]. American Pharmaceutical Reviews 2001;4(3):28-35.
[10]. SangaD, TaraC: Formulation, development and evaluation of enteric coated tablet of sodium valproate by using wet granulation method, Am. J. Pharma Tech., 2013;3(2):6-18.
[11]. HitaV, SinghR, JainSK. Colonic targeting of metronidazole using azoaromatic polymers, development and characterization. Drug Del, 1997;4:19-22.
[12]. Mounica P, Pavani S and Mounica R: A review on recentad vancesinenteric coating and enteric polymer, World Journal of Pharmaceutical Research, 2018;7(2):475-495.
[13]. Vachhani SR, Patel JJ, Patel D, Prajapati ST and Patel CN, J. Chem. Pharm. Res.,2010;2(2):57-64.
[14]. Qiao M. et al A Novel Electrostatic Dry Powder Coating Process for Pharmaceutical Dosage Forms: Immediate Release Coatings for Tablets. European Journal of Pharmaceutics and Biopharmaceutics, 2010;(3):304-310.
[15]. PawarA. Etal Advances in Pharmaceutical Coatings. International Journal of Chem Tech Research, 2010;2(1):733 –737.
[16]. Patentgenius, Phoqus Pharmaceutical Limited Patents. Patentgenius, 2011;3(9): [Cited2012Aug.21], Availablefromhttp://www.patentgenius.com/assignee/PhoqusPharmaceuticals Limited.html
[17]. Goole,J.,Amighi,K.,2016.3Dprintingin pharmaceutics: a new tool for designing customized drug delivery systems. Int. J.Pharm.499, 376–394.
[18]. Goyanes,A.,Wang,J.,Buanz,A.,Martínez-Pacheco,R.,Telford,R.,Gaisford,S., Basit, A.W.,2015.3Dprinting of medicines: engineering noveloral devices with unique design and drug releasech aracteristics. Mol.Pharm.12,4077–4084.
[19]. Aurora J, Talwar N and Pathak V. Colonic Drug Delivery Challenges and Opportunities – An Overview. European Gastroenterology Review,2006; 1-6.
[20]. Sushama P, Suryaprakash M, Pooja H, Nitin R, Sharayu B, Dr.Nilesh MKe: A detail understanding of enteric coated tablet: manufacturing and evaluation, European Journal of Pharmaceutical and Medical Research, 2016; 3(4): 135-144.
[21]. Gobinath T, Kamalakkannan V, Sambathkumar R: Formulation and evaluation of enteric coated tablet of pentoprazole, Journal of Chemical and Pharmaceutical Sciences, 2014; 7(3): 176- 184.
[22]. Ansel H, Allen L, Jr. Popovich N. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems; Eighth Edition, 227- 259.
[23]. A detail understanding of enteric coated tablet: manufacturing and evaluation by Sushama Pole, Suryaprakash Maurya, Pooja Hasnale, Nitin Rathod, Sharayu Bendale, Dr. Nilesh M. Khutle Assistant Professor, Department of Pharmaceutics, Dr. L.H. Hiranandani College of Pharmacy, Ulhasnagar, Maharashtra, India. Pin-421003
[24]. Vidyadhara S, Chowdary YA, Murthy TEGK, Rao MV, Reddy KNK. Influence of electrolytes on controlled release of Ambroxol Hydrochloride from methocel matrix tablets. The Pharma Review 2006; June: 101-104. 24.Jaimini M, Rana AC, Tanwar YS. Formulation and Evaluation of Famotidine Floating Tablets. Current Drug Delivery 2007; 4: 51-55.
[25]. N. Damodharan, V. Manimaran and B. Sravanthi, Formulation development and evaluation of delayed release doxycycline tablets, International Journal of Pharmacy and Pharmaceutical Sciences, 2(1), 2010.
[26]. Patil Ajit, Payghan Santosh and Disouza John, Formulation and Evaluation of Enteric coated tablets of Azithromycin dihydrate, International Journal of ChemTech Research, 3(3), 2011, 1479- 1484.
[27]. D. Raju, J. Padmavathy, V. Sai Saraswathi, D. Saravanan and I. Aparna Lakshmi, Formulation and development of enteric coated tablets of prednisolone as a colon targeted drug delivery, IJPSR, 2(3), 2011,

685-690.
[28]. Raju D, Padmavathy J, Sai SV, Saravanan D and Aparna LI Formulation and development of enteric coated tablets of prednisolone as a colon targeted drug delivery, International Journal of Pharmaceutical Sciences and Research, 2011; 2(3): 685-690.
[29]. Aulton M. Pharmaceutics: The Science of Dosage Form Design. International Student Edition: 304-321: 347-668.
[30]. Patil A, Payghan S and Disouza J, Formulation and Evaluation of Enteric coated tablets of Azithromycin dihydrate, International Journal of Chem Tech Research, 2011; 3(3): 1479-1484.
[31]. Leon Lachman, Herbert A, Liberman, Kaing Joseph L., The theory and practice of industrial pharmacy, Varghese publishing house, Bombay, 3rd edition, 293-295.
[32]. Gazzaniga A, Iamartino P, Maffino G and Sangalli ME, Oral delayed release system for colonic specific drug delivery, Int J Pharm, 1994; 108: 77-83.
[33]. Aurora J, Talwar N and Pathak V. Colonic Drug Delivery Challenges and Opportunities – An Overview. European Gastroenterology Review 2006: 1-6.
[34]. Vachhani Savan R, Patel Jatin J, Patel Dipen, Prajapati ST and Patel CN, J. Chem. Pharm. Res., 2(2), 2010, 57-64