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Review Article

A comprehensive review on fast dissolving pantoprazole tablet: a promising approach for drug delivery.

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ABSTRACT

Besides creating an easy-to-use dosage form for treatment, a revolutionary drug delivery system will increase the safety and effectiveness of therapeutic molecules and improve patient compliance. One such strategy resulted in the creation of fast-dissolving tablets. Fast-dissolving tablets (FDTs) are becoming more and more important today as a result of the variety of medications they can be used for. These are revolutionary tablet forms that dissolve/disperse/disintegrate in saliva in under 60 seconds without chewing or additional water. A popular proton-pump inhibitor (PPI) in clinics and other healthcare settings is pantoprazole. These methods make Pantoprazole pills quickly dissolve in the mouth without chewing or the need for water, which is favorable for children, the elderly, and patients who have trouble swallowing tablets and capsules. The use of super disintegrants and the removal of bitterness is the fundamental strategy adopted in the creation of FDTs for pantoprazole. These oral dose forms offer numerous advantages, including self-medication, improved compliance, simplicity in production, and non-invasiveness. Fast-dissolving Pantoprazole tablets are described in this study along with the necessity for development, difficulties in formulation, suitability of medication candidates, composition, different technologies involved, features, disadvantages, and testing methodology.

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INTRODUCTION

Up to 50–60% of all dosage forms are accepted, including the traditional dose forms (tablets as well as capsules) [1]. The tablet is the most popular dosage form now in use since it is simple to administer on one's own, small in size, simple to produce, and capable of delivering a precise dose [2]. One disadvantage of tablets is that some patients, especially elderly and young patients, may find it difficult to take and swallow them. Fast-dissolving pills provide a solution to this issue. By creating "mouth dissolving tablets," which dissolve quickly in the mouth without water in a matter of seconds thanks to the action of a super disintegrant or a formulation with a maximized pore structure, one such issue can be resolved in a revolutionary drug delivery method [3]. A solid dosage form contains a medical substance or active component that dissolves quickly, typically in a matter of seconds, when placed on the tongue is referred to as a "fast dissolving tablet." Fast-dissolving tablets are specially made for people with dysphagia, elderly people, children, people who are bedridden or traveling, and people who are psychotic and struggle to swallow standard oral formulations. The terms quick-dissolving tablets, mouth-dissolving pills, oral rapid disintegrating tablets, rapid dissolving tablets, porous tablets, and rapid melt tablets are also used to describe fast-dissolving tablets [4]. The employment of excipients such as acdisol, sodium starch glycolate, kollidon, crospovidone,

croscarmellose sodium, and l-hydroxypropyl cellulose, in a concentration of 1.5-7.5%, is the fundamental method employed in the development of FDT. Super particles offer fast tablet disintegration, releasing the medication in saliva and allowing it to be assimilated through the oral mucosa. This direct drug entry into the vascular system results in a rapid commencement of effectiveness. For medications with extensive first-pass metabolism and modest doses, fast-dissolving drug delivery systems are specifically created to increase bioavailability. An essential consideration in the formulation of mouth-dissolving tablets is the absence of the drug's harsh taste [5].

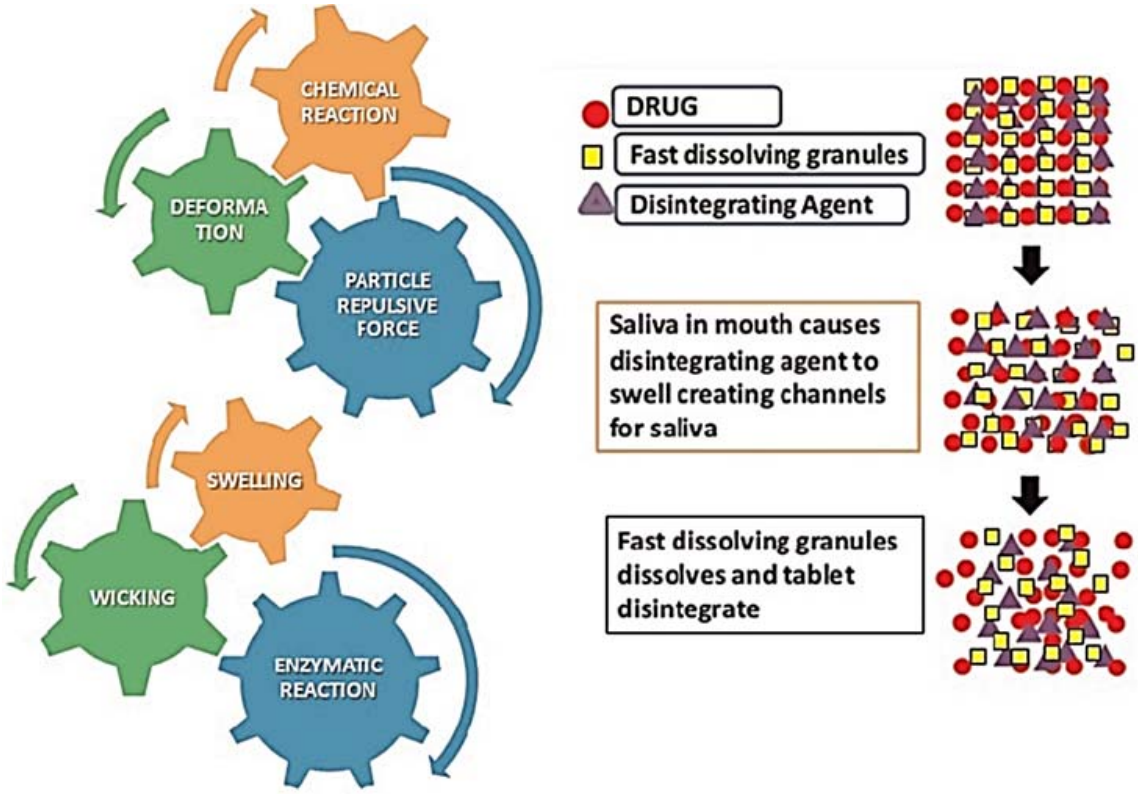

Figure 1. Mechanism of fast-dissolving drug delivery system.

An suppressor of the proton pump is pantoprazole (PPI). It improves acid-related indigestion and heartburn by lowering the quantity of acid in the stomach. The Food and Drug Administration Agency (FDA) has given pantoprazole authorization to treat several disease processes, such as erosive esophagitis linked to gastroesophageal reflux illness and the treatment of pathological hypersecretory diseases, such as Zollinger-Ellison syndrome [6]. Additionally, the FDA has approved it for the sustaining of erosive esophagitis healing. Pantoprazole is also used for a number of off-label purposes, such as the elimination of Helicobacter pylori and the prevention of NSAID- or peptic re-bleeding [7]. Pantoprazole may be administered to critically ill patients as a stress ulcer preventative. Both adult and pediatric populations can safely take this medicine [8].

Mechanism of action of pantoprazole

The benzimidazole series and the imidazopyridine club are the two groups of PPIs. Pantoprazole belongs to the class of PPIs known as benzimidazoles. Because benzimidazoles have a slower metabolism speed than the other two families, their plasma presence is shorter. The H+/K+ ATP pumps are permanently inhibited by pantoprazole, according to its mode of action. With a drop in the pH of the environment, pantoprazole breaks down more quickly. It follows that since the H+/K+ ATP pumps are found in the stomach; this medicine would function best there (specifically within the parietal cells of the stomach lining). The process of producing stomach acid ends at this stage. Pantoprazole binds to these pumps as a result, stopping acid output for up to 24 hours. The second dosage of pantoprazole is necessary to stop the action of newly formed pumps after 24 hours [9]. Rapid action begins right away, and the peak effect is two to six hours after the medicine is administered. Additionally, pantoprazole is broken down in the liver, primarily through CYP2C19 demethylation and sulfation. There is no evidence that these metabolites have any significance [10]. Figure 2 illustrates the precise mechanism of action of Pantoprazole.

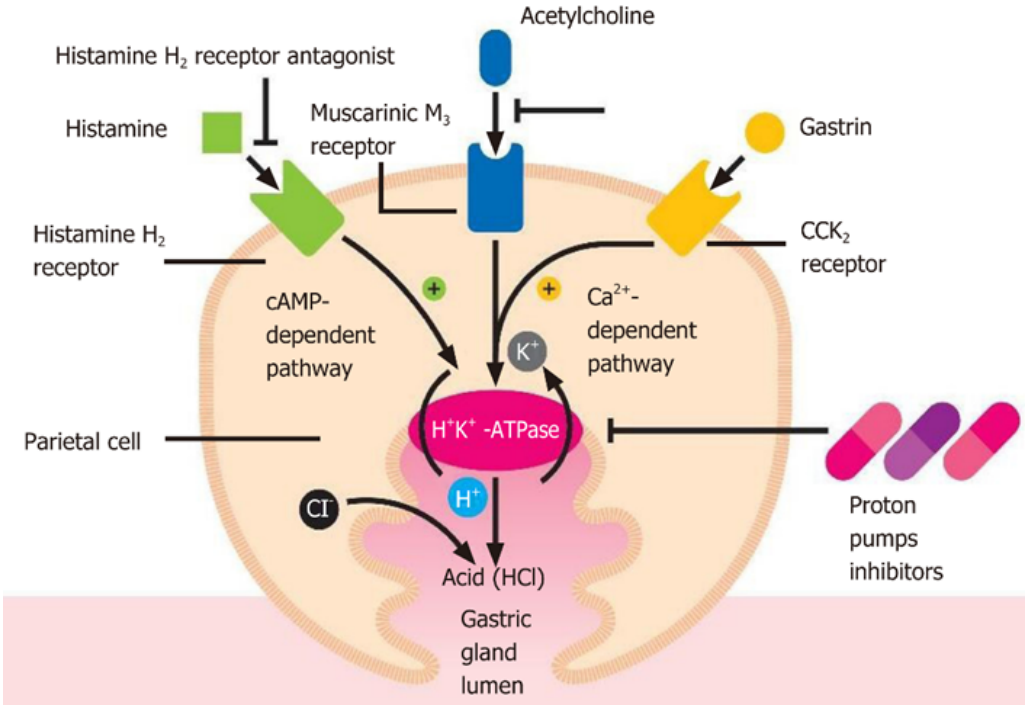

Figure 2. The detailed mechanism of action of pantoprazole.

Merits of FDT of Pantoprazole

- Quick medication absorption and disintegration.
- Preventing first-pass metabolism.
- The dose form can be swallowed dry [11].
- Ease of administration for patients who have trouble swallowing a tablet, such as children, the elderly, and people with mental illnesses 7.
- Compared to liquid preparations, ease of administration and precise dosing.
- Drugs that are hydrophobic and insoluble dissolve and disintegrate more quickly, increasing their bioavailability [12].
- Reducing the chance of suffocating and choking during oral delivery.
- New business opportunities including management system, product differentiation, and marketing product promotion.

Demerits of FDT of Pantoprazole

- They are fragile and brittle.
- FDTs are required to be kept in dry surroundings because of their hygroscopic nature.
- It needs special packaging for protection during storage and transportation [13].
- The tablets usually have insufficient mechanical strength. Hence, careful handling is required during the manufacturing process.
- The tablets may leave an unpleasant taste and/or grittiness in the oral cavity if not formulated properly 14].
- Drugs with larger doses are difficult to formulate.

Challenges

- Mechanical Strength and Disintegration Time: FDTs should have less disintegration time, which is done by maintaining good hardness is a major challenge, because FDTs are easily breakable and have a high chance of breaking during packaging and transporting [15].
- ***Taste Masking***

  Patient compliance and acceptance of a drug are affected when the tablet of bitter drug dissolves in the oral cavity, so the drug is taste masked so that the bitter taste is not felt in the mouth.
- ***Size of Tablet***

  Easy administration of tablets depends on the size of the tablets, which cannot be achieved easily [16].

- *Amount of Drug*

  The weight of the tablet should not be more than 500mg which is challenging when formulating FDTs.

- *Hygroscopicity*
- Under normal conditions of temperature and humidity physical integrity is not maintained by hygroscopic FDTs so they are protected from humidity which is done by special product packaging.

- *Mouth Feel*

  The disintegration of FDTs should not have bigger particles instead the particles should be small with a pleasant mouth feel.

- *Good Packaging Design*

  At the initial stage, packaging design should be improved for protecting FDTs from the environment and moisture [17].

Characteristics of Pantoprazole FDTs

Rapid-breakdown or fast-disintegrating tablets are designed to break down in the mouth when in salivary contact in less than 60 seconds, ideally in less than 40 seconds, creating an easy-to-swallow suspension. It is most commonly referred to as "orodispersible tablets." According to estimates, 50% of people have trouble swallowing pills or tablets. This issue leads to the prescription medication not being taken, which substantially reduces the treatment's efficacy [18]. Therefore, orodispersible tablets are simple to administer for patients who struggle with deglutition or for those who choose to get their medicine without consuming liquids at the same time [19, 20]. Recent developments in novel therapeutic delivery (NDDS) aim to improve patient compliance and the safety and efficacy of the drug molecule by creating an easy-to-use dosage form. Using oral dissolving pills is one such strategy (ODTs). ODTs are solid unit dosage forms that dissolve or disintegrate quickly in the mouth without the usual need for chewing, swallowing, or drinking. The needs of patients are met through advancements in dosage form design for ODTs without sacrificing efficacy. The ODTs meet the patient's needs, which include issues with swallowing traditional pills or capsules [21, 22].

Techniques in Preparation of FDTs

Various methods have been attempted for the formulation of FDTs;

Freeze drying

Drying at a low temperature while making use of sublimation to remove water is known as lyophilization. Medications are placed in a water-soluble matrix and then freeze-dried to create a very porous structure. When inserted in the oral cavity, the lyophilized tablets quickly dissolve in less than 5 seconds as a result of saliva's speedy entry into the pores. Thermolabile compounds, or pharmaceuticals that are sensitive to heat, benefit from lyophilization [23].

Molding

Using this technique, water-soluble components are used to create molded tablets, ensuring quick and thorough dissolution. The powder mixture is wet with a hydroalcoholic solvent before being compressed into tablets at a lower pressure than usual. After that, air drying is used to remove the solvent. Compressed tablets are much more compact than molded tablets. These have porous structures, which speed up disintegration.

Tablet Molding

There are two different types of molding processes: solvent method and heat method. The solvent approach produces fewer compact tablets with a porous structure that speeds up dissolution than compressed tablets do. The mechanical durability of tablets that have been molded raises serious concerns. It is necessary to contain binding agents, which increase the mechanical strength of the tablets. This technique has the additional issue of masking the flavor of the medication particles, which are made by spray congealing a molten mixture of sodium carbonate, cottonseed oil, lecithin, and hydrogenated polyethylene glycol into a lactose-based tablet triturate form. Comparatively to the lyophilization procedure, the molding approach for producing tablets is simpler for industrial manufacturers [24].

Direct Compression

The simplest and most affordable method of producing tablets is direct compression. This method can now be used to create Fast Dissolving Tablets due to the availability of better excipients, particularly super disintegrants and sugar-based excipients.

Spray drying

Powders that are highly porous, fine, and quickly soluble can be produced via spray drying. The foundation of this method is a particulate support matrix, which is created by spray drying an aqueous composition comprising the support matrix and other ingredients to create a tiny, extremely porous powder.

Then, the mixture was compacted into tablets together with the active components. The formulations contain sodium starch glycolate or croscarmellose sodium as a disintegrating agent, hydrolyzed and non-hydrolyzed gelatins as supporting agents, mannitol as a bulking agent, citric acid as an acid and/or an alkali as an alkali, sodium bicarbonate as an acid, and/or sodium starch glycolate as a disintegrating agent. When submerged in an aqueous media, a tablet compacted from spray-dried powder disintegrated in less than 20 seconds [25].

Mass Extrusion

In this method, a solution of water-soluble polyethylene glycol and methanol is used to soften a mixture of the active drug and other ingredients. The softened mass is then extruded through an extruder or syringe to produce a cylinder of product, which is then cut into even segments with the aid of heated blades to produce tablets. Drug granules with strong flavors can be coated with the dried cylinder to hide their flavor [26].

Evaluation of Fast-Dissolving Tablets

Organoleptic properties

Dimensionally describing, tracking, and controlling the tablet's size and shape is possible. Tablet thickness is a crucial element in both duplicating appearance and counting with filling machinery. The homogenous thickness of the tablets is used as a counting mechanism by some filling equipment. A micrometer was used to measure the thickness of ten pills.

Hardness

ODT has a greater strength that is challenging to create because of the complex manufacturing procedures and ingredients. The ODT's maximum allowable hardness is typically kept in the lower range to encourage early dissolution in the mouth. Conventional durability testers can be used to determine the tablet's hardness.

Friability

It can be difficult for a formulator to keep an ODT's% friability within acceptable bounds because all ODT manufacturing processes raise these values. This parameter must therefore be examined, and the findings must fall within the acceptable range (0.1-0.9%).

Wetting time

To measure tablet wetting time, Yunixia et altechnique .'s was used. In a tiny Petri dish (ID = 6.5 cm) filled with 6 ml of Sorenson's buffer pH 6.8, a piece of tissue paper (12 cm X 10.75 cm) was folded twice. On the paper, a tablet was placed, and the duration of complete wetting was timed. The standard deviation and three trials for each batch were also calculated [27].

Packaging

To protect the dosage form, packaging must be handled with extra care during processing and storage. Moisture and physical problems can be resolved by choosing a rigid, multilayer foil-based barrier material. Peelable closure packaging and specialized packaging machinery are utilized for blister packaging because regular push-through blister usage in ODT destroys the tablet. By submerging the blister in water for a predetermined amount of time while it is vacuumed and manually opening the blisters, the final ODT dose form is evaluated [28].

Stability studies

Tablets are subjected to stability testing to determine their product's stability as well as the integrity of their formulations throughout their shelf life. The created formulation needs to be packaged in a particular way. First, it is wrapped with butter paper, then aluminum foil, and finally, it is placed in an aluminum bag and heat sealed. The formulation should be stored at 45 ℃ and 75% relative humidity. Formulas should be kept in storage for three months. Triplicate samples should be collected during the stability research at 0, 1, and 3-month intervals and the tablets should be examined for modifications and drug entrapment [29].

CONCLUSION

Due to the porous tablet matrix or the addition of super disintegrants and/or effervescent excipients, FDTs are novel dosage forms that are specifically created to dissolve in saliva without the need for water. When compared to conventional, fast-dissolving tablets have improved biopharmaceutical characteristics, efficacy, and safety, and have higher patient compliance, particularly in elderly and pediatric populations. A chance for market expansion is also presented by the creation of a fast-dissolving tablet. Another factor in the development of fast-dissolving products is pharmaceutical marketing. As a result, the acceptance of Fast dissolving tablets has increased due to consumer demand and the availability of different technologies, which in turn lengthens the patent life of a drug. For fast-dissolving tablets to be mechanically robust, easy to handle and package, and with production costs compared to regular tablets, it is necessary to optimize manufacturing techniques.

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