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FAST DISSOLVING TABLET: AN APPROACH FOR EMERGENCY TREATMENT

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ABSTRACT
In recent decades, a variety of pharmaceutical research has been conducted to develop new dosage forms. Fast dissolving tablets are one of the fruitful results of these researches. Fast dissolving tablets disintegrate and/or dissolve rapidly in the saliva without chewing and additional water. Mouth dissolving tablets have been formulated for pediatric, geriatric, and bedridden patients and for active patients who are busy and travelling and may not have access to water. This review includes advantages, disadvantages, desired characteristics and various methods used for formulation of fast dissolving tablets.
Keywords: Mouth dissolving, Super disintegrants, FDT, Tablets

INTRODUCTION

Dysphagia, or difficulty in swallowing, is common among all age groups. Dysphagia is common in about 35% of the general population, as well as an additional 30–40% of elderly institutionalized patients and 18–22% of all persons in long-term care facilities. Common complaints about the difficulty in swallowing tablets in the order of frequency of complaints are size, surface, form, and taste of tablets. Geriatric and pediatric patients and traveling patients who may not have ready access to water are most in need of easy swallowing dosage forms[1]. Another study shows that an estimated 50% of the population suffers from this problem. These studies show an urgent need for a new dosage form that can improve patient compliance. Solid dosage forms that can be dissolved or suspended with water in the mouth for easy swallowing are highly desirable for the pediatric and geriatric population, as well as other patients who prefer the convenience of readily administered dosage forms[2].

In recent decades, a variety of pharmaceutical research has been conducted to develop new dosage forms. Recent advances in novel drug delivery systems (NDDS) aim to enhance safety and efficacy of drug molecules by formulating convenient dosage form for administration and to achieve better patient compliance. Considering quality of life, most of these efforts have been focused on ease of medication. Among the various dosage forms developed to improve the ease of administration, the fast dissolving tablet is most preferred product[3]. Fast Dissolving Tablet is a solid dosage form containing medicinal substances, which disintegrates rapidly usually within a matter of seconds, when placed upon the tongue. According to European pharmacopoeia: "A tablet that is to be placed in the mouth where it disperses rapidly before swallowing"[4]. According to FDA fast dissolving tablet ''a solid dosage form containing medicinal substances which disintegrates rapidly, usually within a matter of seconds, when placed upon the tongue''. The tablets disintegrate into smaller granules or melt in the mouth from a hard solid structure to a gel like structure, allowing easy swallowing by the patients. The disintegration time for those tablets varies from a few seconds to more than a minute[2]. The objective of this review is to compile the basic requirements for formulation and methods for formulations.

Advantages of Fast Dissolving Tablets

1. Ease of Administration to the patient who cannot swallow, such as the elderly, stroke victims, bedridden patients, patient affected by renal failure and patient who refuse to swallow such as pediatric, geriatric & psychiatric patients.
2. No need of water to swallow the dosage form, which is highly convenient feature for patients who are traveling and do not have immediate access to water.
3. Rapid dissolution and absorption of the drug, which will produce fast onset of action.
4. Some drugs are absorbed from the mouth, pharynx and esophagus as the saliva passes down into the stomach. In such cases bioavailability of drug is highly increased.
5. Good mouth feel property helps to change the perception of medication as bitter pill particularly in pediatric patient.
6. The risk of chocking or suffocation during oral administration of conventional formulation due to physical obstruction is avoided, thus providing improved safety[5].

Limitations of Mouth Dissolving Tablets

1. The tablets usually have insufficient mechanical strength. Hence, careful handling is required.
2. The tablets may leave unpleasant taste and/or grittiness in mouth if not formulated properly[6].

Requirements of Fast Dissolving Tablets

1. It should not require water for oral administration, yet dissolve / disperse/ disintegrate in mouth matter of seconds.
2. The parent compound has to soluble, stable and able to easily permeate the mucosal barrier be rapidly dissolved while retaining a sufficiently long contact time at the administration site.
3. Incorporating hydrophilic excipients.
4. Able to rapidly absorb water for a rapid deaggregation of the matrix.
5. Tablet must be highly porous.

6. Should leave minimal or no residue in mouth after administration
7. Should have an acceptable taste. If unpleasant taste that can be mask by using suitable taste masking techniques
8. Should have a pleasing mouth feel.
9. Should be harder and less friable.
10. Should exhibit low sensitivity to environmental conditions (temperature and humidity)[7].

Desired Characteristics of Fast Dissolving Tablets [FDT]

Fast disintegration

FDTs should disintegrate in the mouth without additional water or with a very small amount (e.g., 1–2mL) of water. The disintegration fluid is provided by the saliva of the patient. "Fast disintegration" usually means disintegration of tablets in less than 1 minute, but it is preferred to have disintegration as soon as possible.

Taste of active ingredients

Unless the drug is tasteless or does not have an undesirable taste, taste-masking techniques should be used. An ideal taste-masking technology should provide drugs without grittiness and with good mouth feel. The taste-masking technology should also be compatible with FDT formulations. If drug particles are coated to minimize unpleasant taste, the coating should not be broken during compression or dissolved during wet granulation. Taste masking of bitter tasting drugs is critical to the success of the FDT formulations.

Drug properties

For the ideal FDT technology, the drug properties should not significantly affect the tablet property. Many drug properties could potentially affect the performance of FDTs. For example, the solubility, crystal morphology, particle size, hygroscopicity, compressibility, and bulk density of a drug can significantly affect the final tablets characteristics, such as tablet strength and disintegration.

Tablet strength and porosity

The key properties of the tablets are fast absorption or wetting of water into the tablets and disintegration of associated particles into individual components for fast dissolution. This because the strength of a tablet is related to compression pressure, and porosity is inversely related to compression pressure, it is important to find the porosity that allows fast water absorption while maintaining high mechanical strength. A strategy to increase tablet mechanical strength without sacrificing tablet porosity or requiring a special packaging to handle fragile tablets should be provided[8].

Mechanisms of Disintegration

Disintegrates are agents added to tablet (and some encapsulated) formulations to promote the breakup of the tablet into smaller fragments in an aqueous environment thereby increasing the available surface area and promoting a more rapid release of the drug substance[9].

Superdisintegrants: These newer substances are more effective at lower concentrations with greater disintegrating efficiency and mechanical strength. On contact with water the superdisintegrants swell, hydrate, change volume or form and produce a disruptive change in the tablet. Effective superdisintegrants provide improved compressibility, compatibility and have no negative impact on the mechanical strength of formulations containing high-dose drugs[10].

Swelling: Swelling is believed to be a mechanism in which certain disintegrating agents (such as starch) impart the disintegrating effect. By swelling in contact with water, the adhesiveness of other ingredients in a tablet is overcome causing the tablet to fall apart.

Porosity and Capillary Action (Wicking): Effective disintegrants that do not swell are believed to impart their disintegrating action through porosity and capillary action. Tablet porosity provides pathways for the penetration of fluid into tablets. Liquid is drawn up or "wicked" into these pathways through capillary action and rupture the interparticulate bonds causing the tablet to break apart.

Deformation: Starch grains are generally thought to be "elastic" in nature meaning that grains that are deformed under pressure will return to their original shape when that pressure is removed. In other words, the ability for starch to swell is higher in "energy rich" starch grains than it is for starch grains that have not been deformed under pressure. It is believed that no single mechanism is responsible for the action of most disintegrates.

Due to disintegrating particle/particle repulsive forces: This mechanism of disintegration attempts to explain the swelling of tablet made with 'nonswellable' disintegrants. The electric repulsive forces between particles are the mechanism of disintegration and water is required for it[9].

Challenges in Formulating Fast Disintegrating Tablets

Palatability: As most drugs are unpalatable, orally disintegrating drug delivery systems usually contain the medicament in a taste-masked form.

Mechanical strength: In order to allow ODTs to disintegrate in the oral cavity, they are made of either very porous and soft-molded matrices or compressed into tablets with very low compression force, which makes the tablets friable and/or brittle, difficult to handle, and often requiring specialized peel-off blister packing that may add to the cost.

Hygroscopicity: Several orally disintegrating dosage forms are hygroscopic and cannot maintain physical integrity under normal conditions of temperature and humidity. Hence, they need protection from humidity which calls for specialized product packaging.

Amount of drug: The application of technologies used for ODTs is limited by the amount of drug that can be incorporated into each unit dose[11].

Methodology Employed for Fast Dissolving Formulations

The FDT_S are prepared several methods like lyophillization, direct compression, sublimation, molding granulation methods using specific superdisintegrating agents have been utilized to produce the fast dissolving tablet[12-14].

- Direct Compression
- Tablet Molding
- Sublimation
- Lyophilization or Freeze-Drying
- Spray Drying
- Mass Extrusion

Direct Compression

Direct compression is one of the popular techniques for preparation of these dosage forms of its easy implementation, use of conventional equipments along with commonly available excipients, limited number of processing steps and cost effectiveness. The introduction of superdisintegrants has augmented the popularity of this technology. The basic principle involved in development of these dosage forms using this technique is the addition of superdisintegrants in optimum concentration (about 2-5 %) are mostly used so as to achieve rapid disintegration along with the good mouth feel. The disintegrate efficacy of FDTs is strongly affected by tablet size and hardness [15, 16].

Tablet Molding

Molding process is of two type's i.e. solvent method and the heat method. Solvent method involves moistening the powder blend with a hydro alcoholic solvent followed by compression at low pressure in molded plates to form a wetted mass (compression molding). The solvent removed by air-drying. The tablets manufactured are less compact than compressed tablets and possess a porous structure that hastens dissolution. The heat molding process involves preparation of a suspension that contain the drug, agar and sugar (e.g. Mannitol and lactose) and pouring the suspension into blister packing wells, solidifying the agar at room temperature to form a jelly and drying at 30°C under vacuum. The mechanical strength of molded tablets is a matter of great concern. Binding agents, which increase the binding strength of tablets, need to be incorporated [17].

Sublimation

A technique developed to prepare porous tablets which dissolve quickly and rapidly and exhibit good mechanical strength. Subliming materials, inert solid ingredients that volatilize readily (e.g. urethane, urea, ammonium carbonate, ammonium bicarbonate, hexamethylene tetramine, benzoic acid, phthallic anhydride, naphthalene and camphor) were added to other tableting ingredients and the mixture is compressed into tablets. Volatile materials were then removed via sublimation, which generated a porous structure. Additionally, several solvents (e.g. Cyclohexane, benzene, and tertiary butanol) were suggested for use as pore-forming agents [18-22].

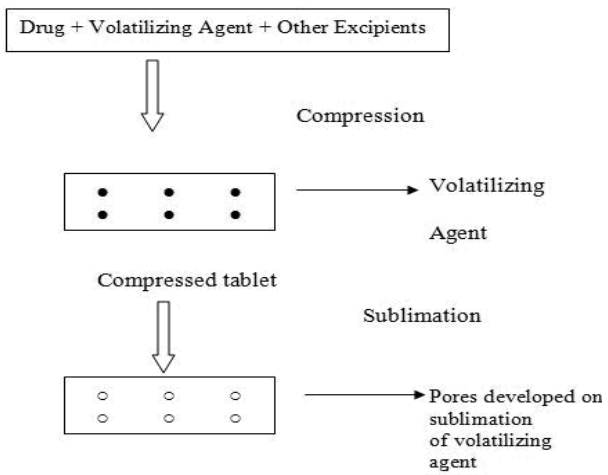

Figure 1: Steps involved in Sublimation

Freeze Drying

Freeze drying (lyophilization) is a process in which solvent is removed from a frozen drug solution or a suspension containing structure-forming excipients. The resulting tablets are usually very light and have highly porous structures that allow rapid dissolution or disintegration. When placed on the tongue, the freeze dried unit dissolves almost instantly to release the incorporated drug. The entire freeze drying process is done at non elevated temperatures to eliminate adverse thermal effects that may affect drug stability during processing. When stored in a dried state, the freeze-dried dosage form has relatively few stability problems during its shelf life. The freeze-drying process may result in a glassy amorphous structure of excipients as well as the drug substance, leading to the enhanced dissolution rate. Freeze drying, however, is a relatively expensive manufacturing process, and the formulation has poor stability at higher temperature and humidity [2, 23].

Spray Drying

Spray dryers are widely used in pharmaceutical and biochemical processing, as the processing solvent is evaporated rapidly, spray drying can produce highly porous, fine powders.

Aqueous composition
⇩
Spray dryer
⇩
Heated to predetermined temperature causing evaporation of substantially all of the aqueous medium and volatilizing agent from droplets
⇩
Dried support matrix
⇩
Preloading of drug
⇩
Add other excipients
⇩
Compression

Figure 2: Preparation of particulate matrix and the tablet

First porous particulate powder, which will serve as the tablet support matrix, is produced. Secondly, pharmaceutically active agent for e.g. Anti-histamine, decongestant, or antibiotic is added to the mixture. Thirdly, the mixture is formed into the tablet. Finally in the forth step, a coating may be applied to the outer surface of the tablet to enhance the tablet intactness and durability of the tablet. Freeze drying technology can also be applied to prepare particulate support matrix technique, to this support matrix which is prepared with freeze drying technique, preloading is done followed by compression[24-30].

Mass Extruction

This Technology involves softening the active blend using the solvent mixture of water soluble polyethylene glycol and methanol and subsequent expulsion of softened mass through the extruder or syringe to get a cylinder of product in to even segment using heated blade to form tablet. The dried cylinder can also be used to coat granules for bitter drugs and there by achieve[31].

CONCLUSION

FDTs offer numerous significant advantages over conventional dosage forms because of improved efficacy, bioavailability, and rapid onset of action, better patient compliance, and acceptance. Pharmacists are in the ideal position to become familiar with the different technologies and educate their patients to what to expect upon taking their first dose. The majorities of the patients receiving FDDTS preparations have little understanding of this new dosage form. Pediatric and geriatric patients are primary concerns, as both the groups find these dosage forms convenient to administer as compared to the conventional dosage forms. FDTs can be prepared in several ways and product performance depends upon the drug suitability and excipients selection in the delivery system. Due to the availability of various formulation techniques, good patient compliance and huge potential, several products have already been commercialized. Furthermore, market size and popularity of these dosage forms will surely expand in future. It is also emphasized that newer with continued development of new pharmaceutical scientific and technological innovations should be undertaken for the emergence of promising and versatile dosage form with novel performance and characteristics for FDTs in days to come.

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