Fast Dissolving Drug Delivery Systems (FDDS): A Review

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Abstract
The ultimate objective of fast dissolving drug delivery system is to provide the tablet that quickly dissolves upon contact with saliva and also provide the good mouth feel. Recently more stress is laid down on the development of organoleptically elegant and patient friendly drug delivery systems for paediatric and geriatric patients. Patient convenience and compliance oriented research has resulted in bringing out many safer and newer drug delivery systems. Rapidly disintegrating / dissolving tablet is one such example, for the reason of rapid disintegration or dissolution in mouth with little amount of water or even with saliva. Significance of this drug delivery system includes administration without water, accuracy of dosage forms, ease of portability and alternative to liquid dosage forms, ideal for paediatric and geriatric patients and rapid onset of action. Fast-dissolving tablets are a cutting-edge method of drug delivery that, with or without water consumption, dissolve, disintegrate, or distribute the API in saliva in a matter of seconds. The absorption and start of the therapeutic action occur more quickly the faster the drug dissolves in the solution.

Both natural and artificial super-disintegrants, such as mucilage, poly vinyl pyrollidone, sodium starch glycolate (primogel), cross-linked carboxymethyl cellulose (croscarmellose), and others, offer instant tablet disintegration and make it easier to create delivery systems with desired properties. For medications used in emergencies, such as cardiac agents, asthama, brain stroke, anti-hyperlipidemic, etc., these kinds of formulations are frequently advised.

Keywords: Fast dissolving drug delivery system, Super-disintegrants, disintegration, dissolution, dispersible, mouth dissolving tablets

Introduction

Fast Dissolving Drug Delivery Systems (FDDS): Kuchekar and Arumugam (2001), in order to provide paediatric and elderly patients with an alternative to traditional dose forms, fast-dissolving drug delivery devices were originally created in the late 1970s. These tablets are made to dissolve or break down quickly in saliva—usually in less than sixty seconds. Chaudhary *et al.,* 2007, Pharmaceutical technologists have created new oral dosage forms called mouth melting tablets (MMTs), mouth dissolving tablets (MDTs), orally disintegrating (dispersible) tablets (ODTs), fast disintegrating (dissolving) tablets (FDTs), or immediate release tablets that dissolve quickly in saliva, typically in a matter of seconds, without the need to take water, in order to meet these medical needs. According to recent market research, almost 50% of patients favour FDTs over alternative dose forms. MDTs are primarily made using two methods. The first involves using super disintegrants such as crospovidone, sodium starch glycolate, and croscarmellose sodium. Using vacuum and freeze drying to maximise the tablets' pore structure is an additional technique. Direct compression is the most favoured option due to its rapidity and affordability (Shailesh and Gupta, 2008).

Chang *et al*., 2000, certain medications may have a higher bioavailability due to oral drug absorption and pregastric absorption of saliva that contains scattered medication that travels down into the stomach. Furthermore, compared to conventional tablets, there is a decrease in the quantity of medication that undergoes first pass metabolism. Bhaskaran and Narmada (2002), the faster dissolving drug delivery system (FDDDS) is a more recent idea that offers benefits over conventional dose forms while combining the benefits of both liquid and solid formulations. Fast-dissolving tablets are a cutting-edge method of drug delivery that, with or without water consumption, dissolve, disintegrate, or distribute the API in saliva in a matter of seconds. The absorption and start of the therapeutic action occur more quickly the faster the drug dissolves in the solution. Tiwari *et al*., 2010, certain medications may have a higher bioavailability due to oral drug absorption or pregastric drug absorption from saliva that travels down into the stomach. Both natural and artificial super-disintegrants, such as mucilage, poly vinyl pyrollidone, sodium starch glycolate (primogel), cross-linked carboxymethyl cellulose (croscarmellose), and others, offer instant tablet disintegration and make it easier to create delivery systems with desired properties. For medications used in emergencies, such as cardiac agents, Asthama, brain stroke, anti-hyperlipidemic, etc., these kinds of formulations are frequently advised. (Shukla *et al*., 2009; Gupta *et al*., 2010)

Feature of Fast Dissolving Drug Delivery System (FDDS) (Kumar *et al*., 2011)

i. Patient compliance is straightforward, and tablet administration is particularly easy for patients with dysphagia, heart and renal problems, bedridden status, and refusal to swallow the dosage form, such as elderly and paediatric patients.
ii. Oral tablet disintegration removes the need for water, making it ideal for people who are on the go and have limited access to it.
iii. Prompt start of activity as a result of fast dissolution and disintegration.
iv. Greater Bioavailability as a result of absorption through the buccal mucosa of the mouth, which has improved permeability characteristics.
v. Any pregastric absorption will enhance bioavailability, lower dosage, and minimise adverse effects, all of which will increase clinical efficacy.
vi. Because the FDT places more of an emphasis on organoleptic qualities, it will provide a pleasant mouthfeel, particularly for paediatric patients.
vii. Because FDT removes choking and airway blockage, it is safer than standard dosing.
viii. Improved business prospects, such as life cycle management, patent extensions, product endorsements, and differentiation.
ix. Beneficial in situations where quick action is needed, such as motion sickness, acute allergic reactions, or coughing.
x. The combined benefits of liquid dose forms (greater absorption) and solid dosage forms (increased stability).

Fast Dissolving Tablet (FDT): Vikas *et al*., 2007, for each of these patients, fast dissolving/disintegrating tablets (FDDTs) are the ideal solution. Fast melting, fast dispersion, rapid dissolve, rapid melt, and/or quick dissolving tablet are other names for the FDT. The Food and Drug Administration (FDA) classifies all FDTs that have been approved as oral disintegrating tablets. The term "Orodispersible Tablet" has been used by the European Pharmacopoeia to refer to tablets that should be placed in the oral cavity and swiftly disperse before being swallowed. Chawdory *et al*., 2012, fast-dissolving tablets are novel dosage forms that were created with the purpose to address some of the issues associated with traditional solid dosage forms, such as difficulties swallowing the pill in the case of elderly and paediatric patients.

Fast-dissolving pills are made to dissolve or break down in saliva in less than 60 seconds, with a range of 5 to 60 seconds. Compared to conventional dose forms, fast-dissolving tablets offer greater patient compliance and acceptance, which may increase biopharmaceutical characteristics, bioavailability, efficacy, convenience, and safety. (Reddy *et al*., 2002; Nautiyal *et al*., 2014)

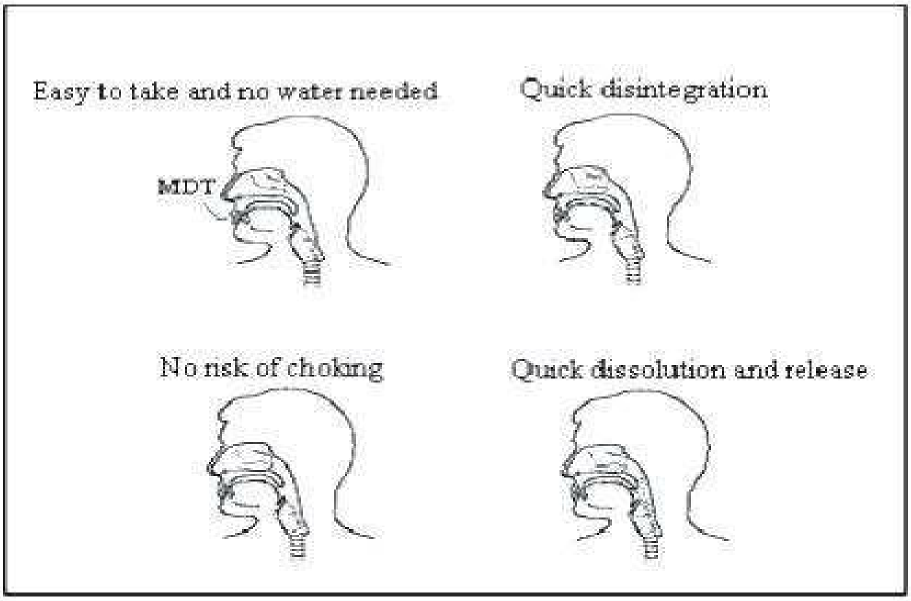

Fig. 1: Advantages of FDT / MDT..

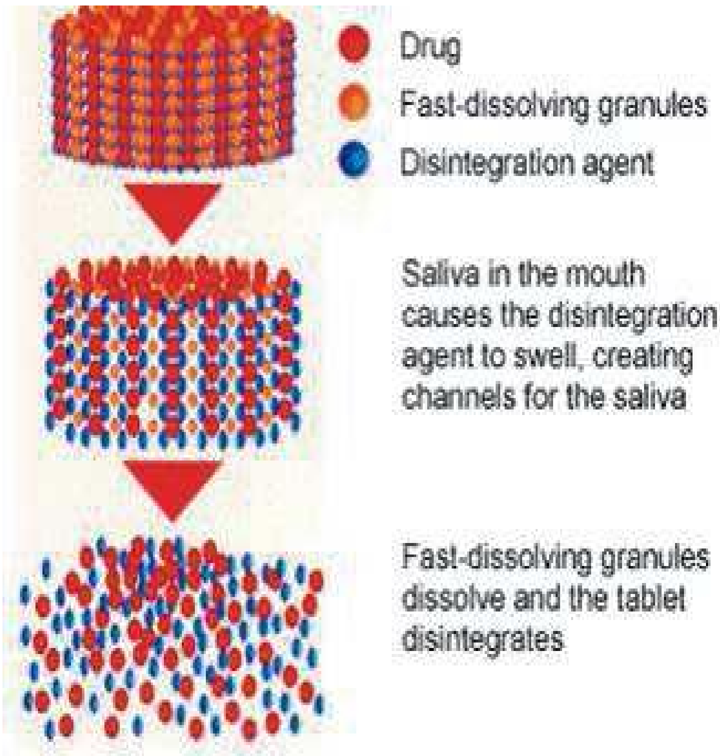

Fig. 2: Mechanism of action of superdisintegrants

Advantages of fast dissolving tablets (FDT) (Deshpande *et al*., 2011)

i. You can swallow the tablet without water;
ii. Patients with mental disabilities, the elderly, children can all receive FDTs with ease;
iii. More precise dosing than with liquids;
iv. The medication dissolves and absorbs quickly, providing a quick start to action;
v. Medication bioavailability is raised;
vi. Benefits over liquid medication in terms of conveyance and administration;
vii. Less first pass metabolism means better bioavailability, which translates into lower dosage and less side effects;

viii. Supplying enhanced security;
ix. Fit for actives with controlled or sustained release;
x. Permits heavy drug loading;

Drugs Eligible for Fast Dissolving Tablet's

Table 1: Drugs formulated as Fast Dissolving Tablets.

Class of Drug	Drug
Anti-inflammatory	Picroxicam, Ibuprofen, Mefenamic Acid
Anti-Bacterial Agents	Erythromycin, Tertacycline, Doxycycline, Rifampin
Anti-Emetic	Ondansetrone, Dolasetron, Granisetron, Promethazine
Anti-Fungal	Griseofulvin, Miconazole
Anti-Malarial	Chlorquine, Amodiaquine
Anti-Gout	Allopurinol, Probenecid
Anti-Hypersentive	Amlodipine, Nefidipine
Anti-Coagulants	Glipizide, Tolbutamide
Anti-Protozoal	Benznidazole, Tinidazole
Anti-Thyroid	Carbimazole
Cardiac Inotropic Agents	Digitoxin, Digoxis
Gastro-Intestinal Agents	Omeprazole, Ranitidine, Famotidine
Nutritional Agents	Vitamin A, Vitamin B, Vitamin D etc
Oral Vaccines	Influenza, Hepatitis, Polio, Tuberculosis etc.

Table 2: Various ingredients of FDTS

S. No.	Type of Ingredient	Concentration (%)
1.	Active pharmaceutical agent	1-25 %
2.	Water soluble film forming polymer	40-50 %
3.	Plasticizer	0-20 %
4.	Sweetening agent	3-6 %
5.	Saliva stimulating agent	2-6 %
6.	Colors and Flavors	0-10 %

Techniques for Preparing Fast dissolving Tablets (FDT) (Srenivas *et al*., 2005)
Numerous methods for creating orodispersible or fast-dissolving tablets have been documented. Here, we've covered the six main methods that are frequently employed in the production of these tablets.

i. Freeze drying/ Lyophilisation
ii. Tablet moulding
iii. Spray drying
iv. Direct Compression

v. Sublimation
vi. Mass Extrusion

Freeze-Drying or Lyophillisation : Chauhan *et al*., 2017, the process of sublimating water out of a frozen product is called freeze drying. The process of freeze-drying has shown to boost bioavailability and improve absorption. The lyophillisation technique's main drawbacks are its high cost and lengthy processing time; also, these goods' fragility renders traditional packaging inappropriate for them, and their low stability under pressured circumstances.

Tablet Molding: Ghosh *et al*., 2011, there are two types of moulding processes: solvent method and heat method. Solvent-produced tablets have a porous structure that speeds up dissolution and are less compact than compacted tablets. One major worry is the mechanical strength of tablets that have been moulded. It is necessary to include binding agents since they increase the tablets' mechanical strength. (Saxena *et al*., 2010)
Spray Drying: Hirani *et al*., 2009, this method makes use of superdisintegrants such crospovidone, sodium starch glycolate, and crosscarmellose, as well as mannitol as a bulking agent and matrix. It has been observed that in an aqueous media, tablets made from spray-dried powder including bulking agent, superdisintegrant, acidic component (citric acid), and/or alkaline ingredient (sodium bicarbonate) dissolve in less than 20 seconds. When compacted into tablets, this spray-dried powder demonstrated enhanced solubility and rapid disintegration.

Sublimation: Gupta *et al*., 2010, Sublimation is the procedure used when volatile chemicals are added to create a porous combination. Compressed tablets may contain highly volatile substances such as urea, phthalic anhydride, camphor, naphthalene, ammonium bicarbonate, ammonium carbonate, benzoic acid, and urethane in addition to other excipients. This volatile substance is subsequently eliminated by sublimation, leaving behind a very porous matrix. It has been claimed that tablets made using this method often dissolve in 10–20 seconds. Pore-forming agents include solvents such as cyclohexane and benzene.

Direct Compression: Saxena *et al*., 2010, the simplest and most economical method of producing tablets is direct compression. This method can currently be used to prepare FDTs due to the availability of better excipients, particularly superdisintegrants and sugar-based excipients. (Reddy *et al*., 2002)

Patented Technologies for Fast Dissolving Tablets
Zydis Technology: Bi *et al*., 1999, Zydis formulation is a special method for making tablets that dissolve quickly. The medication ingredients are physically entrapped or dissolved within the matrix of quickly dissolving carrier polymers in this freeze-dried tablet technique. Water is not necessary for ingesting because the freeze-dried structure dissolves quickly in the mouth when the "zydis unit" is placed there. Zydis material is made up of a wide variety of materials to accomplish certain goals. Alginate and gelatin are added to polymers like dextran to give strength during handling. Good elegance, hardness, and crystallinity are achieved by including saccharides, such as sorbitol or mannitol. Glycine is typically employed as a collapse protectant in freeze-drying processes or long-term storage to stop the shrinkage of zydis units. (Chaudhary *et al.,* 2007)

Limitations
❖ Generally, the maximum quantity of medication that can be added should not exceed 400 mg for insoluble medications and 60 mg for soluble drugs.
❖ To avoid sedimentation during processing, the insoluble drug particles should have a particle size of no less than 50 µm and no more than 200 µm.

Advantages
❖ The buccal, pharyngeal, and stomach regions are all where this formulation is absorbed. Pre-gastric absorption can be advantageous for medications that experience significant hepatic metabolism since it prevents first-pass metabolism.

- ❖ Patients who have trouble swallowing oral medication due to dysphagia, stroke, or medical conditions like multiple sclerosis, Parkinson's disease, or gastroesophageal reflux disease can benefit from the Zydis formulation, which is self-preserving because the final water concentration in the freeze-dried product is too low to allow for microbial growth.

Disadvantages

- ❖ The manufacturing technique of freeze-drying is comparatively costly.
- ❖ The formulation is delicate and lightweight, so it shouldn't be kept in pockets or the bottom of handbags.
- ❖ When temperatures and humidity are higher, it exhibits poor stability.
- ❖ A medicine that is insoluble in water can only be included in tablets containing 400 mg or less. However, only 60 mg of the soluble medication can be used with water.

Durasolv Technology: Nand *et al*., 2010, it is based on direct compression technology, which is patented by CIMA LAB (US patent no. 6,024,981). It makes use of appropriate excipients with increased qualities, particularly superdisintegrants, which speed up the rate of disintegration and, consequently, dissolution. This approach is based on the use of traditional non-direct compression fillers, which dissolve fast and don't leave the mouth feeling sandpapery or gritty. Examples of these fillers are dextrose, mannitol, and sorbitol. It is also possible to employ effervescent and water-soluble chemicals to speed up the disintegration process. Blisters can be packaged with DuraSolv technology, which is intended to deliver stronger tablets without the need for extra packaging precautions. The tablet used in this technology is made up of fillers, lubricants, and medicinal ingredients. (Avani *et al*., 2006)

Advantages

- ❖ With DuraSolv technology, tablets with low active ingredient concentrations (125 mcg to 500 mg) can be compressed to a higher hardness of 15–100 N, which produces an ODT that is more durable.
- ❖ This technology allows for flexible packaging; tablets can be blistered and bottled.

Disadvantages

- ❖ Larger doses of active substances are incompatible with the method because compaction subjects the formulation to high pressure.
- ❖ Durasolv's medicine powder coating may break during compaction, exposing the patient's taste buds to the bitter medication.

Orasolv Technology: Bi *et al*., 1999, Orasolv technology was created by CIMA LAB. Orasolv is a direct compression tablet that dissolves in less than a minute, leaving the coated medication powder, and disperses in saliva in the mouth with the help of a barely perceptible effervescence. Effervescence and covering the powdered medication help to mask its disagreeable taste. Orasolv's mechanical strength as a result of light compression is its main drawback. The matrices in flash dosage technology are made via flash heat processing. Fuisz has a patent on this method. For instance, Biovil Corporation's Nurofen is the first commercial medicine utilising this technique. (Shailesh and Gupta, 2008)

Advantages

- ❖ Taste masking has a two-pronged disintegration. One milligramme to seven hundred milligrammes of medication has been treated with this method.
- ❖ The disintegration time of a tablet can be tailored to be between 10 and 40 seconds, depending on the composition and size of the tablet.

Disadvantages

- ❖ Because of the effervescent mechanism, they are moisture-sensitive and need to be packaged carefully.
- ❖ Inadequate mechanical strength.

Wow Technology: Tiwari *et al*., 2010, Yamanouchi Pharmaceutical Corporation holds the patent for it, where wow stands for "without water." To create a robust tablet that melts quickly, high moldability saccharides such as oligosaccharide and mannitol are combined with low moldability saccharides such as glucose and lactose. (Vani and Amin, 2006)

Advantages: Suitable hardness and rate of dissolving; amazingly, tab products can be packaged in blister packs or regular bottles.

Disadvantages: Not significantly alters the bioavailability.

Shearform Technology: Saroha *et al*., 2010, the preparation of floss forms the basis of this technology. The method of flash heating feed stock that contains a sugar carrier yields floss. A mixture of sucrose, mannitol, or dextrose, and surfactant is thoroughly combined. This is the main mixture of floss. During the flash heat process, the floss is flung concurrently with the carrier materials under centrifugal force. The carrier materials exhibit an internal flow state that is heat induced and exits via a spinning head. The floss created using the previously described method consists of longer fibres that are cut further and then ground into smaller particles using a high shear mixer granulator. The process of recrystallization involves treating floss with 1% ethanol, spraying it out, and then letting it evaporate, which improves the cohesive and flow characteristics.

Flash dose Technology: Saroha *et al*., 2010, this method creates crystalline floss structure by a special spinning mechanism, akin to cotton candy. After that, the medication can be mixed with this crystalline sugar and crushed into a tablet. This type of substance dissolves quickly on the tongue, has a large surface area, and is easily dispersed. The "floss" in the Flash dosage tablets is a self-binding shear form matrix. (Parul and Patel, 2006)

Advantages: High surface area for dissolution

Disadvantage: The usage of medications that are heat-sensitive and moisture- and humidity-sensitive may be restricted due to the high temperature needed to melt the matrix; the dosage form has a maximum capacity of 600 mg of medication. Because the generated tablets are extremely delicate, friable, and sensitive to moisture, special packaging is needed.

Ceform Technology: Deshpande *et al*., 2011; the key to this procedure is to fill a fast-spinning machine with a dry powder that contains only pure medicine and excipients. The dry medication powder is blended at a high speed through a small heated aperture by the centrifugal force of the revolving head of the ceform machine. Because of the precise temperature control and subsequent microburst of heat, this medication blend liquefies to form a sphere. The drug's stability is unaffected by this. The microspheres are either compressed or mixed and then added to the predetermined oral dosage format.

Flashtab Technology: Deshpande *et al*., 2011; the goal of this method is to provide effervescent microencapsulated drugs with quick release in the gastrointestinal tract and easily flash-dispersible tablets. Eudragit is often the polymer used for fast release. This technology follows the traditional method of compression with a traditional wet/dry granulation process. Drug formulation involves the use of taste masking agents, dissolving agents, swelling agents, and drug microgranules. These tablets exhibit strong physical resistance and are strongly recommended for use with hygroscopic materials for blister packing. This is because materials such as aluminium foils and polyvinyl chloride provide superior moisture protection as compared to traditional polyvinyl chloride or polypropylene foils.

Nanocrystal Technology: Giri *et al*., 2010, by increasing surface area and decreasing particle size, the technique improves the rate of dissolution. Drug particles with a diameter of less than 1000 nm are known as nanocrystals, and they are created by milling the drug material using a weight milling approach. Wide range of dosages per unit (up to 200 mg of API per unit) and well-classified products are made possible by nanocrystal quick dissolving technology, which is based on proprietary and patent-protected technology elements. Improved oral medication pharmacokinetics. use of non-moisture-sensitive active ingredients that are economical and efficient.

Advantol 200: Specifically created for use in nutraceuticals With its "Soft-Melt" capability, Advantol 200 is a directly compressible excipient system that doesn't require any specialised manufacturing tools or equipment. Standard rotary tablet presses with standard tooling and typical tableting temperature and humidity levels are needed to produce sturdy "softmelt" tablets.

Advatab: Kyowa Hakko Kogyo (Tokyo, Japan) created and patented the AdvaTabTM technology (Eurand), which creates orally dissolving tablets using a proprietary tablet composition. Every tablet is properly lubricated during the manufacture process by spray. AdvaTab can be 30–40% stronger than regular tablets and is made with 10–30 times less hydrophobic lubricant.

Frosta Technology: This technology's core function is to compress highly plastic granules at low pressures to create robust, high porosity tablets that melt quickly. These plastic granules fall into three categories: binder, enhancer of water penetration, and porous and plastic material. Water soluble or water dispersible materials are porous and plastic. Powders can be plastically deformed to improve the inter-particle interactions that are necessary for the creation of connections between particles. One method of creating these tablets is to combine a plastic that is porous and has a water penetration.

Ora-Quick Technology: Bi *et al*., 1999, KV Pharmaceutical asserts that its exclusive taste masking technology powers their microsphere technology, dubbed Micro Mask. It produces tablets faster and more effectively because it doesn't require any kind of solvent. Additionally, it produces less heat, which is advantageous for medications that are heat-sensitive. This technology promises improved tablet flavour masking and faster disintegration times. This technique assesses characteristics including flavour, mouthfeel, physical strength, bioavailability, stability, and rate of absorption and dissolution.

Pharmaburst Technology: This technology has a patent from SPI Pharma, New Castle. Using coprocessor excipients, it dissolves in 30 to 40 seconds. With this method, the medication, flavour, and lubrication are blended dry and then compressed into tablets. The resulting tablets are strong enough to be packaged in bottles and blister packs.

Lyoc : Verma *et al*., 2017, farmlyoc has patented a technology called Lyoc. The technique attempts to create a solid and porous galenic of an oil-in-water emulsion inside the blister alveolus through lyophilization. The bulk drug or drug microparticles are then frozen in blisters made by this emulsion mixture. Because it is porous, the locomotive product has a low mechanical strength but a high rate of disintegration. One such product is Farmlyco Phloroglucinol Hydrate. Similar to Zydis, Lyoc uses a freeze-drying method, except their product is frozen on the shelves of the freeze-dryer.

Mechanism of Super disintegrants:
The following are the four main ways that tablets disintegrate:

Swelling: Superdisintegrants that function through this mechanism attack the underlying causes of "swell" and "burst." The Super-Disintegrant experiences swelling and/or tablet breaking when it comes into contact with water or saliva because the aqueous phase applies more adhesive force to the superdisintegrant than to other excipients and drugs. This mechanism is used by the majority of Superdisintegrants.

Porosity and Capillary Action (Wicking): According to this method, the tablet's particles are mostly surface wetted in the specified aqueous medium. Next, water seeps into the tablet's centre, weakening the interparticle link and facilitating the tablet's shattering. As a result, it is known as capillary action or wicking because the moisture gradually rises within the tablet until the tablet breaks. In this case, the tablet's porosity is crucial as it's a necessary condition for quick and simple wetting and water absorption. The rate of wetting increases and the disintegration time decreases with increasing material porosity.

Particle/Particle Repulsive Forces: Chang *et al*., 2000, Guyot-Hermann has put forth a theory of particle repulsion. According to this view, the swelling occurs through "nonswellable" disintegrants in tablets. This operates on the basis of particles' electric repulsive force. The biological enzymes function as disintegrants in this method. The pill contains binders that are readily broken down by salivary enzymes. These binders become catalysed when they come into touch with saliva, which causes the pill to dissolve. The swelling and burst phenomena, in which the binder swells and bursts to release medication as granules, is likewise coupled with this mechanism. Examples include the metabolism of alginate by Carragenase, sucrose by Invertase, gums by Hemicellulose, and binder starch by Amylase.

Deformation: Sunada *et al*., 1999, in general, it is believed that starch grains are "elastic," meaning that when pressure is applied, they will revert to their former shape. However, because of the compression forces used during tableting, it is thought that these grains are permanently damaged and are "energy rich," with the energy being released when they come into contact with water.

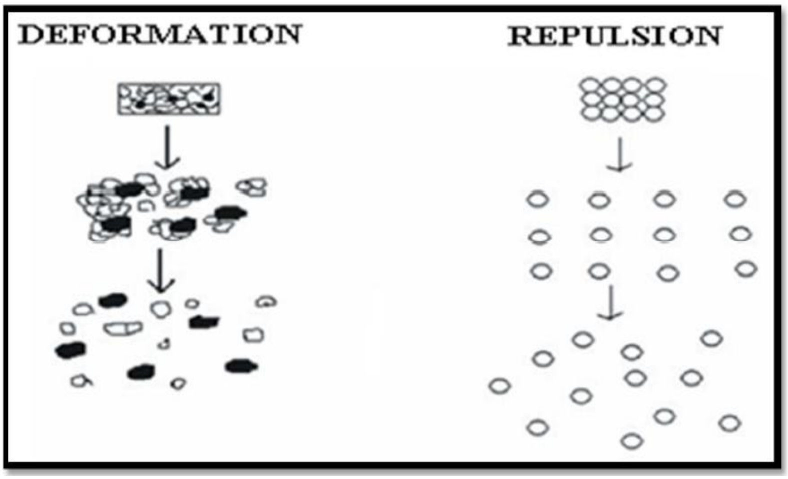

Fig. 3: Disintegration by Deformation and repulsion.

Evaluation Parameters

Table 3: Evaluation parameters of FDT

Parameters	Criteria
Weight Variation	Weight Variation tests according to USP, IP, BP; (Prajapati and Ratnakar, 2009)
Hardness	Hardness of the tablet should be less than conventional tablet (3-4kg/cm^2); (Zade *et al*., 2009)
Friability	Friability : 0.1-0.9%. (Vaishali *et al*., 2016; Gandhi, 2012)
Mechanical Strength	Must have sufficient mechanical strength to withstand shock during transit and prevent tablet breaking;
Tablet Porosity	Tablet porosity as per ICH guideline; (Nautiyal *et al*., 2014);
Wetting time and water absorption	Utilising artificial saliva to measure how long a tablet takes to wet and how much water it absorbs; (Sharma, 2013)
In-vitro Dispersion time	The amount of time needed for a pill to dissolve in media at an ideal, set pH and temperature is calculated. (Sharma *et al*., 2015)
Disintegration	In aqueous medium, the duration of tablet disintegration is

Studies	measured; (Nayak and Manna 2011; Irfan *et al.*, 2015)
Dissolution	Dissolution Studies carried out according to USP, IP, BP; (Chauhan *et al.*, 2017; Saka and Singh, 2012)
Stability Studies	The ICH guidelines are followed for conducting stability investigations, including accelerated stability studies.
Content Uniformity	Content uniformity according to USP /IP /BP (Saka and Singh, 2012)

Challenges of Fast Dissolving Tablet's

Despite the advantages of this formulation, it faces number parameters that come across as a challenge. These are listed below.

Table 4: Challenges faced while preparing FDT.

Parameter	Description
Palatability	The medication should be sweet in character, easily administered, and palatable to the patient. This is difficult because most medications have an unpleasant taste. (Vaishali *et al.*, 2016)
Mechanical Strength	In addition to the excipients provided, the tablet should have maximum mechanical strength and not break easily or become friable. This presents a hurdle because the medication needs to have strong mechanical strength and dissolve quickly in the oral cavity.
Hygroscopicity	This formulation is hygroscopic, meaning that when it comes into touch with water, it should dissolve or disintegrate. Therefore, a challenge and a limiting step constitute the formulation's essential mechanism.
Aqueous Solubility	If a medicine is hydrophobic or extremely lipophilic, its aqueous solubility becomes a serious problem because it won't dissolve or disintegrate in the mouth, leaving behind residue and grittiness.
Tablet Size	The ideal size for oral dissolving tablets is 7-9 mm, and they shouldn't be larger. (Reddy *et al.*, 2002)
Drug Concentration	Drugs with a narrow therapeutic index or those with significant potency can only be developed into FDTs. These little pills use the least amount of excipients and have a low medication concentration. As a result, not all medications work well with this formulation. (Gandhi, 2012)

Palatability: Vaishali *et al.*, 2016, **s**ince most medications are tasteless, FDTs typically include the medication in a form that masks its flavour. FDTs dissolve or disintegrate in the patient's mouth after ingestion, releasing the active components that come into contact with the taste buds. For patients to comply with treatment, taste-masking of the medications becomes essential.

Mechanical strength and disintegration time : Roser and Blair, 1998, FDTs are either made of a very porous and soft-molded matrix or are compressed into tablets with very low compression force, which makes the tablets friable and/or brittle, difficult to handle, and frequently requiring specialised peel-off blister packing that may increase the cost. This allows the tablets to disintegrate in the oral cavity. The only tablet technologies that can make tablets strong and long-lasting enough to be packed in multi-dose bottles are wow tab and durasolv.

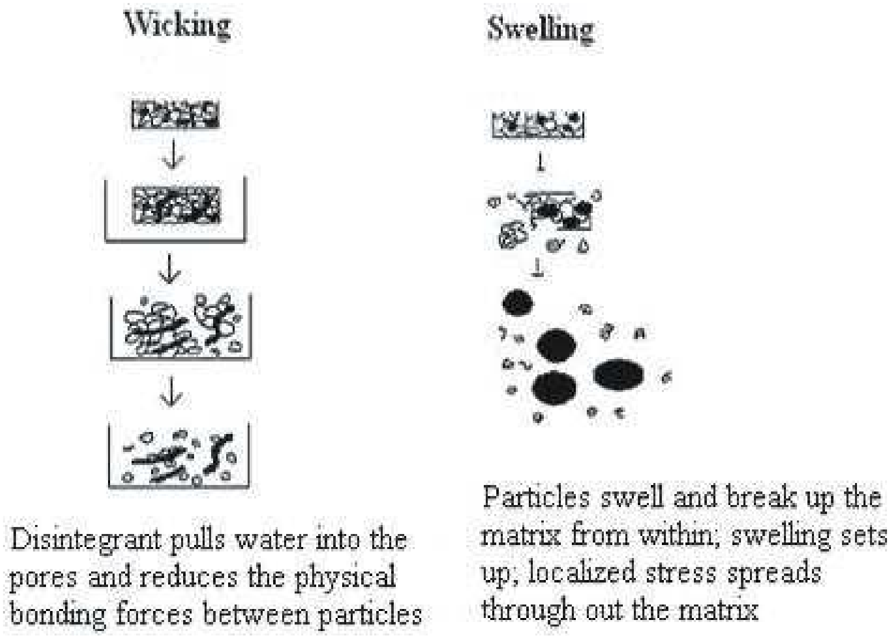

Fig. 4: Disintegration of Tablet by wicking and swelling.

Hygroscopicity: Roy (2016), under typical temperature and humidity circumstances, a number of orally disintegrating dosage forms cannot preserve their physical integrity due to their hygroscopic nature. Because of this, they require humidity protection, necessitating the use of specialised product packaging.

Amount of drug: Gandhi (2012), the amount of medicine that can be added to each unit dose restricts the deployment of FDT technology. Drug dosages for lyophilized dosage forms must be less than 400 mg for insoluble substances and 60 mg for liquid substances. This characteristic presents a significant challenge when creating oral films or wafers that dissolve quickly.
Aqueous Solubility : Sehgal *et al*., 2012, because they create eutectic mixtures, which induce freezing-point depression and the production of a glassy solid that may collapse upon drying due to loss of supporting structure during the sublimation process, water-soluble medications present a number of formulation issues. Using different matrix-forming excipients, like mannitol, which can cause crystallinity and provide the amorphous composite stiffness, might occasionally stop such collapse.

Size of Tablet: Reddy *et al*., 2002, tablet's size affects how simple it is to take. It has been shown that tablets in the sizes of 7-8 mm are the simplest to swallow, whereas tablets larger than 8 mm are the easiest to handle. It is therefore challenging to create a tablet that is both convenient to carry and manage.

Mouth feel: In the mouth, FDTs shouldn't break down into bigger particles. Particles formed following the FDTs' disintegration ought to be as little as feasible. Additionally, the oral feel is improved by the inclusion of flavours and cooling substances like menthol.

Sensitivity to Environmental Conditions: Shailesh and Gupta (2008), since the majority of the materials used in FDTs are designed to dissolve in a small amount of water, FDTs should show minimal susceptibility to environmental factors like humidity and temperature.

Criteria for excipient used in formulation of FDTs

i. Their unique characteristics shouldn't have an impact on the FDTs.
ii. It needs to be fast to break down.
iii. It shouldn't interfere in any way with other excipients or drugs.
iv. The ultimate integrity and stability of the product must be considered carefully when choosing a binder (a single binder or a combination of binders).
v. The excipients that are employed should have melting points between 30-35°C.
vi. It shouldn't affect the product's organoleptic qualities or efficacy.
vii. The type of the binder can be liquid, semi-solid, solid, or polymeric.

Excipients used in FDT Preparation: FDTs use a minimum of one super disintegrant, a lubricant, a diluent, and optionally sweeteners, flavourings, permeabilizing agents, swelling agents, and lubricants.

Limitations of FDTs

i. The primary drawbacks of FDTs are to the tablets' mechanical strength.
ii. The highly porous and soft moulded metrics or low compression of FDT make the tablet brittle and friable, making it challenging to handle.
iii. Drugs with unpleasant tastes are challenging to develop as FDT; more care needs to be taken when formulating such a medicine.
iv. A unique package is needed for many FDT since they are hygroscopic and cannot preserve their physical integrity in normal humidity conditions.
v. It's possible that these tablet formulations are not suitable for people who have dry mouth from reduced saliva production.
vi. The rate at which the saliva solution is absorbed and the total bioavailability. Stability of drugs and dose forms.

Superdisintegrants : When it comes to direct compression procedures, superdisintegrants are primarily responsible for the disintegration and eventual breakdown of the fast-dissolving tablets. Additional components like effervescent agents and water-soluble excipients speed up the disintegration process even more. The faster disintegrating formulation is becoming more and more in demand as time goes on. Therefore, the chemist must create super disintegrants, or disintegrants that are more effective intragranularly and dissolve at lower concentrations with higher disintegration efficiencies. These super disintegrants work by swelling, and when swelling pressure is applied in a radial or outward direction, it can break tablets or expedite water absorption, which increases granule volume dramatically and aids in disintegration.

Factors to be considered for selection of super disintegrants

Disintegration : For the tablet to disintegrate swiftly in the mouth, the disintegrant must wick saliva into it quickly in order to create the hydrostatic pressure and volume expansion required.

Compactibility: To make sturdy tablets without requiring special packaging and to maximise manufacturing speed, it is preferable to have FDT with sufficient hardness and reduced friability at a given compression force.

Mouthfeel : Large particles may cause the mouth to feel grainy. Smaller particles are therefore desired. However, if the tablet absorbs water and becomes gel-like in consistency, many users find the gummy feel to be unpleasant.

Flow : Super disintegrants typically make around 2–5% weight percentage of the tablet formulation. Disintegrant level can be substantially higher when using FDT formulation.

Bulking Materials : Bulking elements play a crucial role in the creation of tablets that dissolve quickly. They serve as a filler, diluent, and cost-cutting tool. In addition to adding volume and lowering the concentration of the active ingredient in the formulation, bulking agents improve the texture of the tablets, which subsequently increases the disintegration in the mouth. Between 10% and 90% of the final composition's weight is added in bulking agents. Particularly bulking agents (such as dextrose, fructose, lactitol, maltitol, maltose, mannitol, sorbitol, starch hydrolysate, polydextrose, and xylitol) with high aqueous solubility and sweetness contribute to taste masking properties and pleasant mouth feel, making them frequently used sugar-based excipients. Excipients based on sugar can be categorised according to how quickly they dissolve and mould:

i. Lactose and mannitol are examples of type 1 saccharides, which have a high rate of dissolution but a low moldability.
ii. Maltose and maltitol are examples of type 2 saccharides, which have a low rate of dissolution but a high moldability.

Emulsifying Agents : Emulsifying agents are important because they facilitate rapid drug release and disintegration without the need for chewing, swallowing, or drinking water, which is important when manufacturing fast dissolving tablets. Emulsifying chemicals also improve bioavailability and stabilise immiscible mixes. For quick-dissolving tablet formulations, emulsifying agents come in a range of forms, such as lecithin, sucrose esters, propylene glycol esters, and alkyl sulphates. These can be included in the final formulation at a weight percentage ranging from 0.05% to about 15%.

Lubricants: These excipients can help make the tablets taste better once they dissolve in the tongue, even though they are not necessary. Lubricants lessen grittiness and facilitate the passage of medications from the mouth into the stomach.

Flavours (taste masking agents) and Sweeteners : Patients find the items more appetising and pleasant when flavours and taste masking agents are added. The addition of these components helps mask the bitterness and off-putting flavours of some active substances. Synthetic and natural tastes can be combined to improve the organoleptic properties of quickly dissolving tablets. There is a large variety of sweeteners available, including sugar, fructose, and dextrose, as well as non-nutritive sweeteners like sucralose, aspartame, sodium saccharin, and sugar alcohols. The mixture gains body and a pleasing taste with the addition of sweets.

Techniques for preparing fast dissolving tablets

Freeze-drying or lyophilisation: This is a pharmaceutical procedure that enables the removal of water by sublimation while applying suction to dry heat-sensitive medications and biological materials at low temperatures. Lyophilization processes are characterised by high porosity and specific surface area, as well as quick oral dissolution, which results in excellent medication bioavailability. This system's fragility, expensive cost, and labor-intensive process make traditional packing unsuitable for packaging. The quick melting effect of this process results in tablets with excellent mouthfeel and a very short disintegration time.

Moulding Method: Hydrophilic chemicals are used in the design of tablets in order to achieve maximal medication disintegration. A hydroalcoholic solvent is used to moisten the powder bulk before compressing it into a dosage form. After then, the solvent system is left to evaporate. By spray-congealing a molten combination of hydrogenated cottonseed oil, sodium carbonate, lecithin, and polyethene glycol with an active component into lactose-based tablet triturate, the taste of the medication particles is formed. The removal of solvents by drying results in a porous material that facilitates quick dissolution, giving the moulding procedure its highly porous characteristics.

Melt Granulation : A meltable binder is used in the process of "melt granulation technique," which effectively agglomerates pharmaceutical powders. Compared to wet granulation, this technique takes less time and energy because there is no drying step. This method is helpful for increasing the pace at which medications that are poorly soluble in water, like griseofulvin, dissolve.

Mass Extrusion : Nayak and Manna (2011), using methanol as a solvent, the water soluble ingredient polyethene glycol softens the mixture before it is fed through an extruder to create thin cylinders. They are then cut into little tablets by slicing them with a hot knife. The ability to disguise bitter-tasting medications by forming tiny granules improves the oral bioavailability of this approach.

Sublimation : Roser and Blair (1998), Ammonium bicarbonate, urea, camphor ammonium carbonate, and hexamethylene-tetramine are examples of inert solid substances that volatilize quickly and can be quickly formulated into porous mass to achieve rapid disintegration and dissolution. They were compressed after being combined with additional components. By applying a small amount of heat and decreasing pressure, the volatile substance is evolved, leaving the mass porous. The sublimation method's characteristics include their porous nature and the ability to use solvents like benzene and cyclohexane.

Direct Compression : Sharma *et al*., 2015, for the following reasons, the disintegrant addition technology (direct compression) is the method of tablet manufacturing that is most favoured: it is possible to accommodate high doses and get a tablet final weight that is greater than that of other methods; simplest method for producing the tablets; generally accessible excipients and standard equipment are employed; there are only a few processing steps required; economic efficacy. The disintegrant effectiveness is highly influenced by the size and hardness of tablets. Tablets that are huge and hard take longer to dissolve than usual. Small, extremely soft pills have little mechanical strength. In order to get rapid disintegration and high dissolution rates, the best sort and concentration of disintegrant should be selected. Disintegration time, however, stays relatively constant or even rises over the threshold concentration level.

Cotton Candy Process : Arora and Sethy (2013), the reason this technique gets its name is that it uses a special spinning mechanism to create a crystalline structure that resembles cotton candy and looks like floss. The process of making cotton candy involves simultaneously spinning and flash melting polysaccharides to form a matrix. The resulting matrix is partially recrystallized for better compressibility and flow characteristics. After milling and blending this candy floss matrix with excipients and active substances, it is compressed to form FDTs.

Spray Drying : Sharma *et al*., 2015, by using hydrolyzed and nonhydrolyzed gelatins as supporting agents, mannitol as a bulking agent, sodium starch glycolate or crosscarmellose sodium as disintegrating agents, and an acidic (like citric acid) or alkali (like sodium bicarbonate) material to improve disintegration and dissolution, the ingredients are integrated. The spray-drying method's characteristic is that when the dosage form comes into touch with the aqueous medium, it dissolves quickly within 20 seconds.

Table 5: Fast dissolving dosage forms are available for various therapeutic areas.

S. No.	Target population	Therapeutic areas
1.	Paediatric	Antibiotics
		Anti-asthmatics
		Cough/cold/Allergy
		Anti-epileptics
		Analgesics/Antipyretics
		Antidepressants
		Parkinson’s
		Antimigraine

2.	Adult and Elderly	Alzheimer’s
		Anti-emetics
		Cancer
		Diabetes
		AIDS
		Gastric Relief
		Psychotherapeutics
		Cardiovascular
		Cough/ Cold/ Allergy
		Analgesics/ NSAIDS

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