Oral disintegrating tablets: best approach for faster therapeutic action of poorly soluble drugs

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Drug carrier networks are sophisticated because pharmaceutical scientists gain a greater understanding of the performance of biochemical as well as physicochemical parameters. Oral disintegrating tablets (ODTs) are now more commonly available for the treatment of various diseases than other products. Due to its convenience in terms of manufacture and administration, the oral administration route is being studied as the most utilized route. ODTs, particularly for pediatric patients, are considered to be effective drug-delivery systems due to their quick disintegration properties, water-free usage, and ease of swallowing. 'Orally disintegrating tablets' are present in solid dosage forms that dissolve in the mouth in less than 60 s without the need for water. Rapid tablet disintegration leads to rapid dissolution and therefore rapid action. ODTs are an ideal treatment for specific populations such as unconscious patients, bedridden patients, dysphagic patients, psychotic patients, geriatric patients, pediatric patients, and young patients with underdeveloped nervous and muscular systems. The main aim of this research paper is to discuss the advantages, drawbacks, formulation problems, manufacturing methods, patented technology, evaluation tests, and marketed formulations of ODTs, their value, different technologies, ideal characteristics, and aspects of formulation and design, future perspectives, and marketed preparations, particularly for pediatric patients.

Keywords:
geriatrics, mass extrusion, orally disintegrating tablets, patient compliance, pediatrics

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Introduction

In the Orange book, oral disintegrating tablets (ODTs) are described by the United States Food and Drug Administration (FDA) Center for Drug Evaluation and Research as a solid dosage form that contains a medicinal substance or active ingredient that disintegrates rapidly within a matter of seconds when placed upon a tongue. European pharmacopoeia defined ODTs as 'uncoated tablets intended to be placed in the mouth where they disperse rapidly before being swallowed' and as tablets that should disintegrate within 3 min.' Oral disintegrating tablets were established and after that ODT new technologies compensate several pharmaceuticals as well as the needs of patients, from enhanced life cycle management to comfortable dosage of patients with psychiatric, geriatric, and pediatric disease [1]. During the last 3 decades, ODTs, as a preferable alternative to traditional capsules and tablets, became very popular due to their improved compliance in terms of patient conditions [2–4]. ODTs are known to be rapid-disintegrating, mouth-dissolving, rapid-dissolving, and orodispersible tablets. Oral tablets that disintegrate quickly in the mouth are intended to disperse before swallowing, and the active ingredient is intended for absorption and gastrointestinal delivery [5,6]. Furthermore, in the context of the disintegration test performed by United States Pharmacopoeia (USP), the FDA recommends that oral disintegration tablets must be regarded as solid oral preparations that disintegrate quickly in the mouth with an in-vitro disintegration period close to about 30 s [7,8]. The oral route is known to be the most favored administration route and capsules as well as tablets are considered as the most desired dosage forms. In the pharmaceutical industry, this is presently the gold standard, as it is the most convenient, economical, and safest drug-delivery approach with high patient compliance, whereas many drawbacks are seen such as swelling and choking in pediatric and geriatric patients [4,9–16]. Oral administration is considered the common route as it has many advantages such as versatility, pain avoidance, and ease of ingestion (to accommodate different kinds of drugs), as well as significant patient compliance [17]. Furthermore, solid oral delivery systems do not require sterile conditions; thus, they are considered less expensive for manufacturing [18]. The development of new drug types for oral administration is the focus of a wide spectrum of pharmaceutical studies. Many of

these activities focus on either establishing or improving patient conformity with the implementation of new drug-delivery technologies. The orally disintegrating systems were among the most common modes of delivery designed to administer treatment. In the same way, the oral cavity is highly suitable for patients; with a high degree of blood flow and complete absence of langerhans, the oral mucosa is extremely permeable to possible allergens [19]. A new approach for the formulation of ODTs has been developed. The current medication delivery devices such as Oral Disintegrating Mini Tablets (ODMTs) incorporate the benefits of ODTs and microtablets for pediatric therapies. This is why large and limited sizes of ODTs for pediatric patients can be described as ODMTs [20]. A tablet that dissolves with a Tip of the tongue is the distinction between strange and sublingual. The first ODT medication form to be accepted by the USA, The Zaydis ODT Claritin (loratadine) formulation, was approved by the FDA in December 1996 [21].

Need for development of oral disintegrating tablets

The ODT was a precursor to the tablets intended to dissolve on the mucous membrane of the mouth (cheek). This method of dosage was developed for drugs that have low bioavailability across the digestive tract, which are not appropriate for parenteral administration. Noninvasive supply mechanisms are important because customers have failed to adopt and comply with current delivery systems, there is limited market space for pharma and medication applications, and there is a high clinical control expense involved. These are not the only concerns.

Orally disintegrating tablets are more suitable for the consumer and can provide superior biopharmaceutical effects, increased potency, and greater protection than traditional oral doses. Orally disintegrating dosage formulations are especially suited for patients who are unfamiliar with swallowing standard water capsules and tablets, patients who cannot swallow properly because they are scared of choking, and patients who have constant nausea, are driving, or have limited to no access to water. ODT is an alternative form of dosage to improve bioavailability in patients who have problems in swallowing and who need to continue their tasks quickly. Also, the tablets can be consumed without water.

Synonyms of oral disintegrating tablets

In this literature review, different names, for example, orodispersible tablets, fast melting, rapid/fast dissolving, fast dispersing, fast disintegrating, and rapidly disintegrating tablets, are used for ODTs. Also, in ODMTs, all these synonyms and also quick dissolution mini tablets are used [22–24].

Ideal properties of oral disintegrating tablets

The ideal properties of ODTs like environmental conditions, compatibility, strength, and taste are shown in Table 1 and Figure 1.

Advantages and disadvantages of oral disintegrating tablets

Clinical, and formulation-related and patient-related advantages of ODTs are shown in Figure 3, and the disadvantages like insufficient mechanical strength, unpleasant taste, hygroscopic nature, special package, and large doses are difficult to overcome. The disadvantages of ODTs are shown in Figure 2.

Major mechanisms of oral disintegrating tablets

The major mechanisms of ODTs include an enzymatic mechanism, wicking, swelling, chemical reaction, deformation, and particle repulsive force. The detailed characteristics of ODTs are shown in Figure 3.

Factors to be considered for the selection of the drug

Factors to be considered for the selection of the drug depend on various factors, which include taste, dose, stability, and pKA. The detailed illustration is shown in Figure 4.

Limitations of oral disintegrating tablets

The mechanical power of the tablets is always inadequate. Meticulous care is also required. If not prepared correctly, the tablets can leave an unpalatable taste and residue in the oral cavity. Drugs that require to be administered at high doses will make ODTs difficult to formulate. ODTs are not suitable for patients who also take anticholinergic medications [26–28].

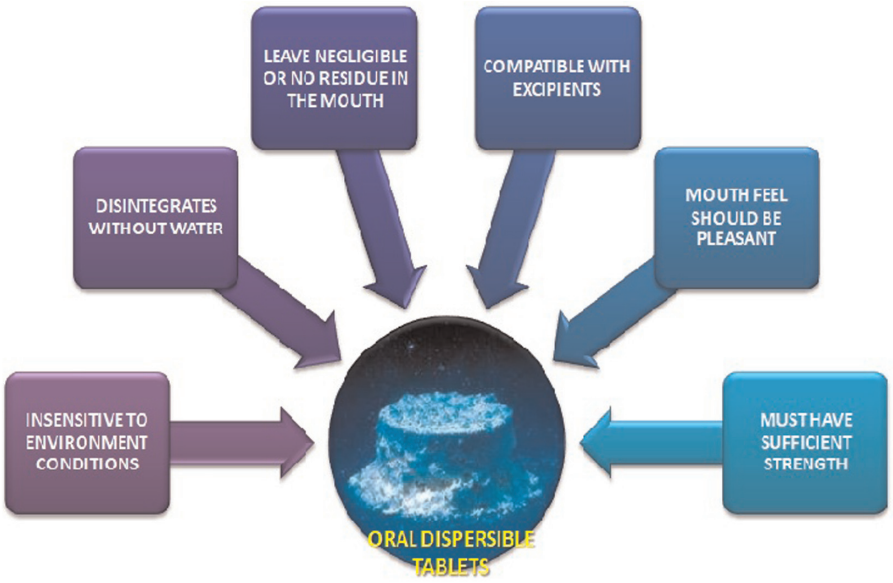
Challenges in the formulation of oral disintegrating tablets [29–31]

Mechanical strength and disintegration time: if the mechanical strength is higher, strong coordination

Table 1 Ideal properties of oral disintegrating tablets

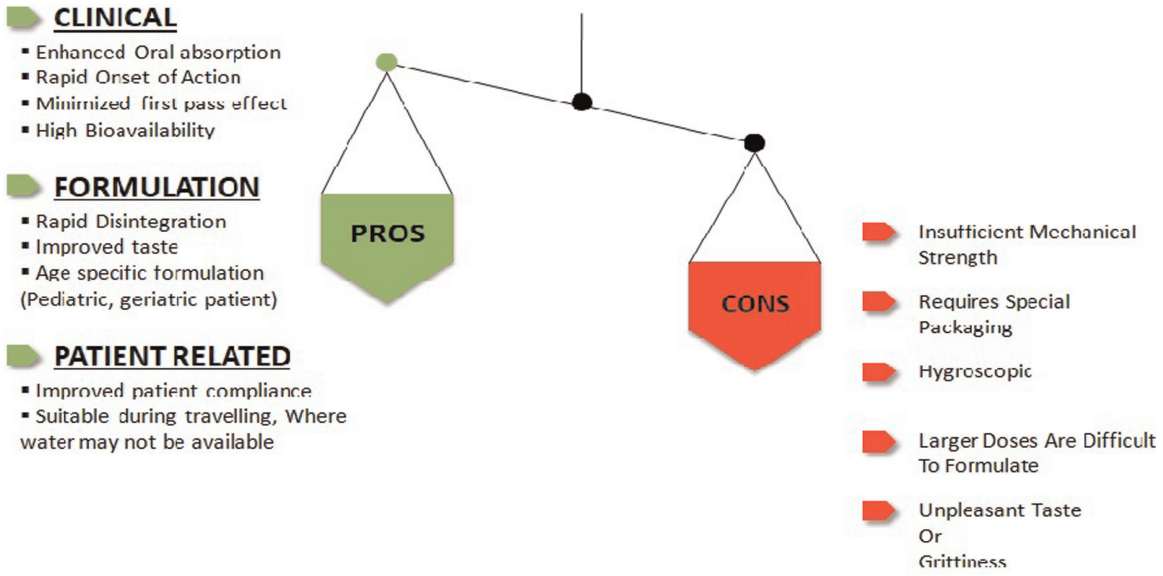
Sl. no.	Properties	Yes/no
1	Portable	Yes
2	Patient compliance	Yes
3	Cost-effective	Yes
4	Compatible with taste masking	Yes
5	Better mouth feel	Yes
6	Friability	No
7	Environmental factors	No
8	Requirement of water for swallowing	No

Figure 1



Ideal properties of oral disintegrating tablets.

Figure 2



Pros and cons of oral disintegrating tablets.

between these parameters will always be required. The disintegration time will increase. The bitter taste of drugs is masked effectively; therefore, the taste in the oral cavity is not felt. After ODT disintegration, the particles formed should be very small in size. After oral administration, ODT does not leave any trace in the mouth. The taste in the mouth can be improved by cooling agents and flavors such as menthol. ODTs must have less sensitivity to environmental conditions like temperature and humidity. The methods used to formulate an ODT must be appropriate and cost-effective (Table 2).

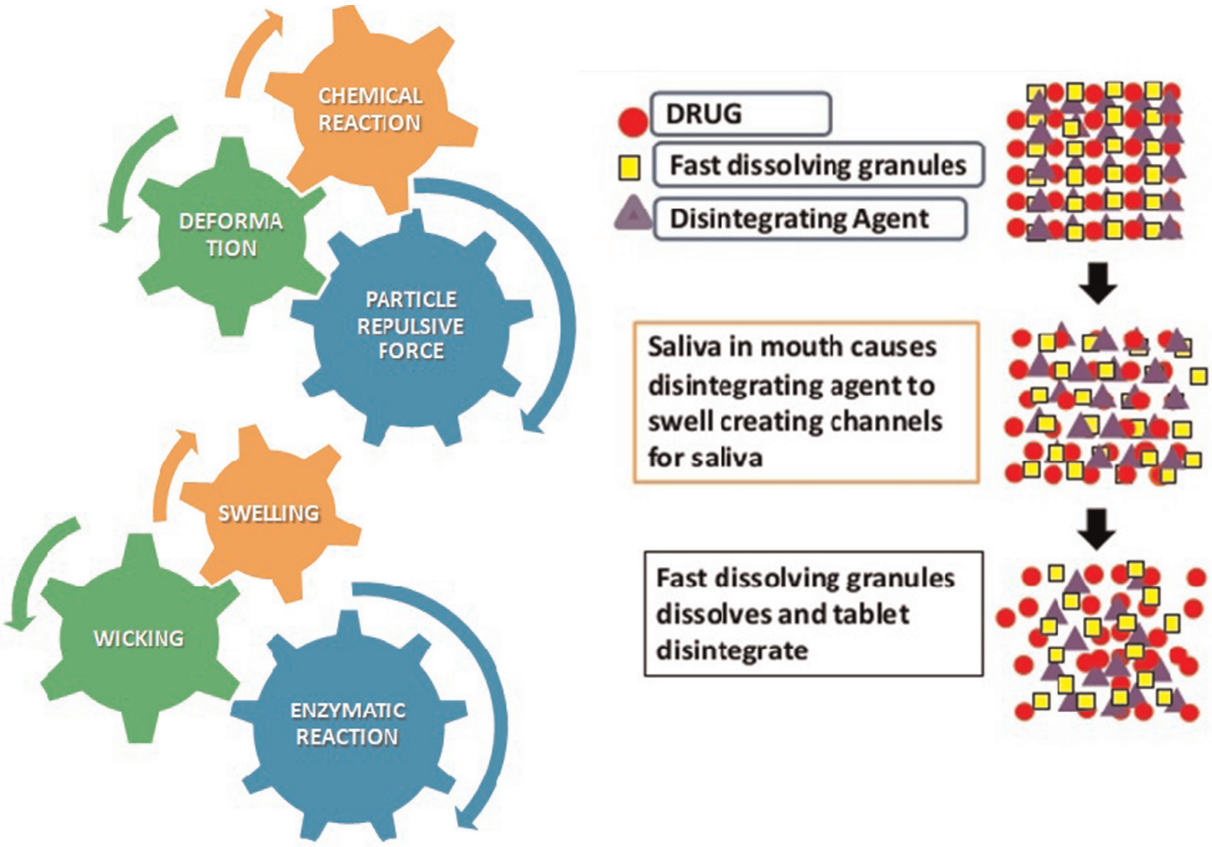
Excipients used in oral disintegrating tablets

Various excipients used in ODTs like binders, super disintegrating agents, diluents, and antistatic agents with examples [32–35] are shown in Table 3.

Mechanisms of oral disintegrating tablets [36]

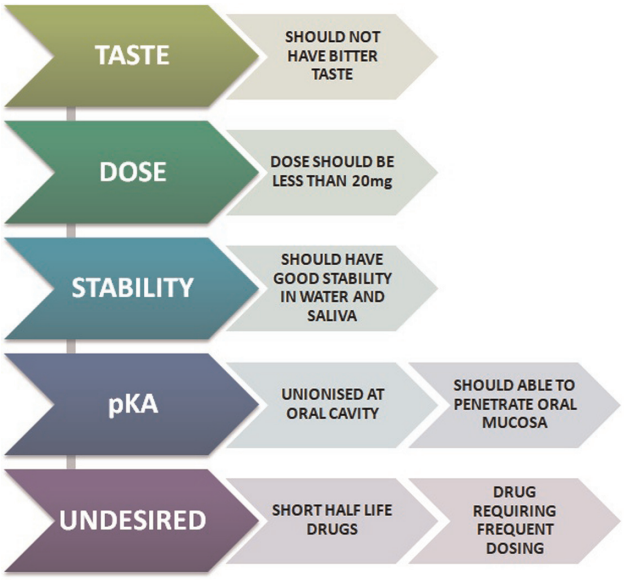
ODTs have the following structures for the fast dissolution characteristics: to induce rapid deterioration and eventual breakdown of the tablet, water should rapidly enter the tablet matrix. A decomposing agent or extremely water-soluble excipients should be included in the composition of

Figure 3



Mechanisms of oral disintegrating tablets [25].

Figure 4



Factors to be considered for the selection of a drug.

the tablet. There are several processes by which a tablet is divided into smaller particles and the drug is dissolved or suspended. The required mechanisms are as follows:

(1) Capillary action.
(2) Chemical reaction.
(3) High swell ability of disintegration.

Methods used for the preparation of oral disintegrating tablets

The rapidly dissolving properties of the ODTs require the rapid entry of water into the tablet matrix, which involves some basic approaches such as optimizing the porous tablet structure, adding the correct disintegrating agent, and using highly soluble excipients. Excipients that are used in ODTs are composed of superdisintegrants (swelling and wicking mechanisms, or both), flavorings, sweeteners, permeabilizing agents, swelling agents, lubricants, and diluents. Different methods for preparation exist according to different principles and lead to various properties of ODTs through bioavailability, dissolution profile, swallowing ability, taste, mouth feel, stability, and mechanical strength [37].

Spray drying

This method is based on the use of a spray drying particle support matrix. A support matrix as well as other aqueous materials made into a very porous and

fine powder, and then disintegration and breakdown are enabled by adding effervescent ingredients and spray drying to create a pore powder [38].

Characteristics: prepared tablet disintegrates within 20 s when immersed in an aqueous medium.

Phase transition process

This method involves the preparation of tablets with low and high melting points containing sugar alcohol; after heating, adequate longevity for tablets resulted in improved bonding of particles. Conventional and herbal oral disintegrating tablets available in the 'market and Table 5 Patented technologies with advantages were shown in Tables 4 and 5.

Characteristics: the compatibility increased and so the formulation gained sufficient hardness.

Table 2 Challenges in the formulation of oral disintegrating tablets

Sl. no.	Challenges	Description
1	Mechanical strength and disintegration time	MDTs (mouth-dissolving tablets) are commonly designed for less than a minute of disintegration. During this time, it is a prime challenge to maintain good mechanical strength. Several MDTs are delicate, and all of these delicate tablets will breakdown when packed, shipped, or handled. Increasing the mechanical capacity would prolong the decommissioning process
2	Mouth feel	Tablet does not disintegrate in the oral cavity into larger fragments. The particles produced by the tablet should be as small as possible after disintegration. After oral administration, the tablet should leave a minimum or no trace in the mouth
3	Palatability	Since most of the drugs are undesirable, tablet should be masked in flavor
4	Mechanical strength	They are manufactured from extremely porous and soft-modeled matrices or packed in very low compressing strength tablets to allow ODTs to disperse in the oral cavity, thereby rendering them friable and/or brittle, difficult to treat, and often needs a professional pullout blister packaging that can make up the bill
5	Hygroscopic property	Many other dose disintegrating oral tablets are hygroscopic and, under natural circumstances of humidity and temperature, cannot retain physical integrity. They also need moisture protection, which needs special product packaging
6.	Cost	In terms of the final product cost, the technologies adopted for an ODT should be appropriate
7.	Taste masking	The bitter taste of drugs is masked effectively; therefore, the taste in the oral cavity is not felt

Table 3 Various excipients used in oral disintegrating tablets

Sl. no.	Type of excipients	Example	W/W %
1	Binders	Polyvinylpyrolidone, polyvinyl alcohol, hydroxypropyl methylcellulose, etc.	5–10%
2	Super disintegrating agents	Polacrilin potassium, modified corn starch, carboxy methylcellulose, microcrystalline cellulose, sodium starch glycolate, crospovidone, Croscarmellose sodium, etc.	1–15%
3	Diluents	Magnesium trisilicate, calcium sulfate, Magnesium carbonate, etc.	0–85%
4	Antistatic agents	Polyoxyethylene stearates, polyoxyethylene sorbitan fatty acid esters, sodium dodecyl sulfate, Sodium lauryl sulfate, etc.	0–10%

Table 4 Conventional and herbal oral disintegrating tablets available in the 'market

Brand name	Active ingredients/scientific name	Company
Nimulid-MD Nimesulide Panacea Biotech	Zyrof meltab Rofecoxib, Zydus Cadila	MOSID-MD Mosapride Citrate Torrent
Pharmaceuticals	Feledine Melt Piroxicam Pfizer	Maxalt ODT Famotidine Merck
Remeron Sol Tab Mirtazapine Organon	Romilast Montelukast Ranbaxy	Manza BDT Olanzepine Orchid
Olanexinstab Olanzepine	Valus Valdecoxib Glenmark	Rofaday MT Rofecoxib Lupin
Herbal' oral disintegrating tablets		
Ashwagandha	*Withania somnifera*	Banyan botanicals
Mandukaparni (Gotu-kola)	*Centella asiatica*	Banyan botanicals
Kanchanar Guggulu	Bauhinia variegate *Commiphora mukul*	Banyan botanicals
Shatavari	*Asparagus racemosus*	Banyan botanicals
Arjuna	*Terminalia arjuna*	Banyan botanicals
Amalaki	*Emblica officinalis*	Banyan botanicals
Neem	*Azadirachta indica*	Banyan botanicals
Haritaki	*Terminalia chebula*	Banyan botanicals
Turmeric	*Curcuma longa*	Banyan botanicals

Table 5 Patented technologies with advantages

Patented technology	Basic technology	Technology developed by company	Active ingredient (brand names)	Advantages
Zydus	Lyophilization	R.P. Scherer, Inc.	Loratidine (Claritin Reditab and Dimetapp Quick Dissolve)	Quick dissolution, self-preserving, increased bioavailability
Quicksolv	Lyophilization	Janssen pharmaceutics	Cisapride monohydrate (Propulsid Quicksolv), Risperidone (Risperdal M-Tab)	Its taste masking is twofold; quick dissolution takes place
Lyoc	Lyophilization	Farmalyoc	Phloroglucinol Hydrate (Spasfon Lyoc)	–
Flashtab	Direct Compression	Ethypharm	Ibuprofen (Nurofen FlashTab)	It requires only conventional tableting technology
Orasolv	Direct Compression	Cima Labs, Inc.	Paracetamol (Tempra Quicklets), Zolmitriptan (Zolmig Repimelt)	Its taste masking is twofold; quick dissolution takes place
Durasolv	Direct Compression	Cima Labs, Inc.	Hyoscyamine Sulfate (NuLev) Zolmitriptan (Zolmig ZMT)	Higher mechanical strength than Orasolv, good rigidity
Wowtab	Direct Compression	Yamanouchi Pharma Tech. Inc.	Famotidine (Gaster D)	
Ziplets	Direct Compression	Eurand International	Ibuprofen (Cibalgina DueFast)	Good mechanical strength, handling problems during manufacturing are avoided
Advatab	Microcaps and Diffuscap CR Technology	Eurand International	Adva Tabcetrizine, AdvaTab Paracetamol	–
Flashdose	Cotton Candy Process	Fuisz Technology, Ltd.	Tramadol HCl (Relivia Flashdose)	It has a high surface area for dissolution
Oraquick	Micromask Taste Masking	KV Pharm. Co. Inc.	Hyoscyamine SulfateODT	Faster and efficient production, appropriate for heat-sensitive drugs
Fuisz	Sugar based matrix known as Floss	Fuisz Pharmaceutical Ltd.	Diphenydramine and Pseudoephedrine	–

Freeze-drying/lyophilization

This method is based on the elimination of a solvent from an excipient-forming frozen drug solution or suspension. Also, the process resulted in an exceptionally light and porous shape [39].

Characteristics: the preparations are highly porous, have a high specific surface area, dissolve rapidly, and ultimately show improved absorption and bioavailability.

Molding

Consumption of water-soluble products, mainly sugars, is accomplished through the process. A very fine film is then damped with a hydroalcoholic solvent and formed into tablets under heat; the material is evaporated by air drying. Powder mixing is achieved by drugs and other excipients.

characteristics: molded tablets are not as compact as compressed tablet porous structures, which promotes disintegration/dissolution, and finally, increases absorption.

Melt granulation

This method effectively aggregates the powders by utilization of a binder, which may either be liquid or molten, utilizing high shear mixers and increases the temperature above the binder melting point [40].

Characteristics: it melts in the mouth and solubilizes rapidly, leaving no residue. It is prepared by compressing a powder containing two sugar alcohols with high and low melting points and subsequently heating at a temperature between their melting points. The hardness of the tablet was increased after the heating process due to an increase of the interparticle bond induced by the phase transition of lower melting point sugar alcohol.

Sublimation

For sublimation, inert hazardous compounds such as camphor, urea, etc., are added to additional tablet excipients and mixed into tablets. The sublimation consequently creates a pore structure for the removal of hazardous compounds [41].

Characteristics: porous structure enhances dissolution using a volatile material or solvent, for example, cyclohexane, benzene, etc.

Mass extrusion

A water-soluble solvent mixture methanol and polyethylene glycol are used for the softening of the active mixture. After the extruder or syringe expels the saturated masses in cylindrical shapes, they are cut into segments by a heated blade that is used to shape the tablets.

Characteristics: the dried product can be used to coat granules of bitter-tasting drugs, thereby masking their bitter taste.

Cotton candy process

This process forms the polysaccharide matrix by simultaneous actions of fast spinning and melting. This candy-floor matrix is then combined and compressed to a rapidly dissolving tablet with active medications. The characteristics of this procedure are high dosage levels and high mechanical strength in this dosage form [42].

Characteristics: it can accommodate high doses of a drug and offers improved mechanical strength.

Nanonization

The wet grinding process reduces the particle size to nanoscale. The nanocrystals formed are then stabilized to avoid agglomeration on the surface of inert material by physical means [43]. This methodology is ideal for low-bioavailability water-insoluble products, cost-effective, and reduce the tension and retain a wide variety of doses (≥200 mg).

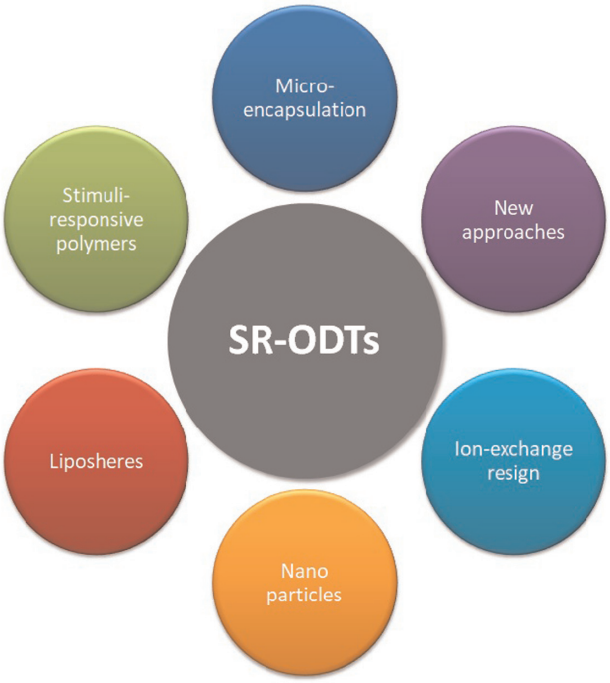
Characteristics: it is used for poor water-soluble drugs. It leads to higher bioavailability and reduction in dose, a cost-effective manufacturing process, allows conventional packaging due to exceptional durability, and inclusion of a wide range of doses (up to 200 mg of drug per unit).

Compaction

With melt granulation, hydrophilic waxy (super poly-state) binder PEG-6-stearate is added to the formulation. This binder has many actions; it also promotes disintegration, increasing physical intensity. Medicines like griseofulvin can easily be supplied as a dose. The compaction process is distinguished by its quick melting, without leaving any residue in the mouth [44].

Characteristics: the compatibility increased and so sufficient hardness is gained by the formulation.

Figure 5



New technologies of sustained-release oral disintegrating tablets.

Current sustained-release technologies in oral disintegrating tablets

A new method for sustained release can be used in an ODT for providing more benefits by decreasing the requirement for several daily dosing schemes and increasing patient adherence [45]. Several new methods including ion-exchange resins, stimuli-responsive polymers, and polymer-coated nanoparticles have been developed for producing robust SR-ODT ('Sustained Release Orally Disintegrating Tablets'). (Figs. 4 and 5).

Quality control tests for oral disintegrating tablets

The quality control tests are categorized into two main types: postcompression and precompression formulations.

Precompression techniques

The ODT powder mixture consists of clear precompression tests. Such tests include Carr's index, bulk density, and Hausner ratio, repose angle, and tapped density [46].

Determination of the angle of repose

In loose powder, the frictional force is calculated by the repose angle (h). Newman described the repose angle experimentally and the following formula was obtained: Tan $\varnothing = h/r$ [47].

Determination of bulk density

Bulk density is defined as the powder weight (g) over the volume of the powder (cm^3). In this, the density value is directly proportional to the powder's size range, particle size, and adhesive tendency. Accurate values of bulk densities are particularly significant for the preparation and selection of suitable tablet packaging materials [48].

Determination of tapped density

The tapped density is conveniently measured by utilizing tap density equipment after calculation of the bulk volume of the material. The tap density unit is normally set to 300 taps and carried out for 500 taps per minute. Volume is defined by (Va) and filmed again 750 times. If Vaas well as Vb differ by not less than 2% Vb, the final volume is taken into account and the following formula is used to quantify it [49].

Tapped density = Weight of powder/Tapped volume

Postcompression tests

The final ODTs are subjected to postcompression tests. Such tests involve determination of weight variations, dissolution test, wetting time, moisture uptake, water-absorption ratio, friability, hardness, weight, in-vivo and in-vitro disintegration time, thickness, and taste evaluation [25].

Weight variation method

The weight variance value is calculated according to the USP protocol of both the disintegrating tablets and the ODMTs. The weight of a single tablet is measured using 20 tablets. The norm and relative variance values are determined and then weighted separately for each of the 20 tablets. The weights of the ODMTs need to be smaller than ODTs to be used effectively by children. The ODMT weight variance values for pediatric applications, in particular, should be calculated [50].

Hardness

Hardness may be defined as a force that is applied around the tablet width. The hardness value of every tablet is calculated by measuring the default deviation value [51].

Thickness

Tablet thickness is significant as it influences the presentation and packaging of tablets. Statistically, the thickness of a total of 20 tablets is determined as well as evaluated [52].

Friability

The number of tablets calculated is then weighed (first weight) and placed in a friabilator. The tablets are first rotated for 4 min at 25 rpm in the friabilator. The weight loss of tablets is measured by the calculation of friction and is shown as a percentage [53]. After the examination, the tablets are weighed again.

As per USP, 'Value must be less than 1'

% Friability=initial weight–final weight×100 initial weight.

Dissolution test

For dissolution experiments on ODTs, USP apparatus 1 or 2 may be utilized. Apparatus 1 will clamp the pores on the tablet as well as cause some dissolution profile errors if a tablet-forming part is used. This is why the paddle procedure known as apparatus 2 is widely used for ODT dissolution testing. Usually, rotation of 50 rpm is desired, but the rotation speed can be up to 100 rpm for masked ODT formulations. Ultraviolet spectroscopy as well as high-pressure liquid chromatography are widely used to determine the quantity of the dissolved active agent using analytical methods. According to the FDA, a minimum of 85% should be dissolved within 30 min [54] of the active ingredient in ODT formulations.

Wetting time

Wetting time is the indication of the inner structure of the tablets and hydrophilicity of the excipients. Thus, the wetting time of a dosage form is related to the contact angle. The lower the wetting time, the quicker the disintegration of the tablets. The wetting time can be measured using five circular tissue papers 10 cm in diameter, which are then placed in a Petri dish of 10 cm diameter. 10 milliliters of water-soluble dye like eosin solution is added to the Petri dish. The tablet is carefully placed on the surface of a tissue paper [55]. The time required for water to reach the upper surface of the tablet is noted as the wetting time. For measuring the water-absorption ratio, the weight of the tablet before it is placed in the Petri dish is noted (W_b). The wetted tablet from the Petri dish is taken and reweighted (W_a). The water-absorption ratio.

R, can be determined according to the following equation:

$$R = 100(W_a - W_b)/W_b$$

Moisture-uptake studies

Moisture-uptake studies are carried out to assess the stability of the tablets. 10 tablets were placed in desiccators over calcium chloride at 37°C for 24 h. The tablets were then weighted and exposed to 75% relative humidity at room temperature for 2 weeks. The required humidity was achieved by placing a saturated sodium chloride solution at the bottom of the desiccators for 3 days. One tablet as a control (without a super disintegrant) was placed to assess the moisture uptake due to other excipients. Tablets were weighed and the percentage increase in weight was recorded [55] (Tables 4, 5).

Future of oral disintegrating tablets

A broad variety of therapeutic agents containing generics are used for ODT technology, which adds value in, for example, 'supergenerics' for use in humans or in veterinary applications [56–58]. Some new methods of quality management are created for determining the methods used to describe the characteristics of ODT tablets for oral disintegration [59]. Peptide-based and protein-based therapies used orally, or instant-release capsules, have restricted bioavailability. In the gastrointestinal system, this form of product typically degrades instantly. Delivery of high-molecular-weight peptide as well as protein [60] has been very efficiently performed in an ODT system that is spread and/or absorbed in the saliva. The development of ODT-controlled release properties, which will enable delivery of drugs that have brief half-lives of 12–24 h will be a revolutionary advancement in ODT technology. Enhanced compliance and convenience with use of certain formulations are observed [61]. Moreover, it will provide another major technical advancement for formulating drugs in large doses. ODT formulations usually require high concentrations of excipients, and when large doses are required, the final formulation can simply become too large to administer. A breakthrough would be when ODT formulations are needed less than the drug itself [62]. ODT technology is on track; thus, it is challenging to construct an ODT formulation that includes lipophilic active pharmaceuticals. To find a solution to this issue, new ODT technologies should be developed [63].

Conclusion

ODTs have major advantages over traditional oral dosages because they enhance bioavailability, rapid onset of action, convenience, and conformity, which are of interest to many manufacturers. For several ODT manufacturers, potential problems include decreasing prices when customers seek alternatives to produce new appliances, product types, taste masking ability, and improved mechanical efficiency. Therefore, patient demand and access to different technologies have improved the acceptability of ODTs.

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Conflicts of interest

There are no conflicts of interest.

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