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REVIEW ON APPROACHES TO DEVELOP ORODISPERSIBLE TABLETS(ODT'S)

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ABSTRACT

Formulation of a convenient dosage form for administration, by considering swallowing difficulty and poor patient compliance, leads to development of orally disintegrating tablets. This is also called as orodispersible, mouth dissolving, rapidly disintegrating, and fast melt system. This disintegrates in the mouth in seconds without chewing and the need of water which is advantageous mainly for paediatrics, geriatrics and patients having difficulty in swallowing tablets and capsules. Conventional preparation methods are spray drying, freeze drying, direct compression, Moulding, and sublimation etc, while new technologies also have been developed for the production of orodispersible tablets. This review depicts conventional, recent and patented technologies that are used to prepare orodispersible tablets in detail.

KEYWORDS: Orodispersible tablets, Approaches, Superdisintegrants, Conventional techniques, Patented technologies.

INTRODUCTION

- The tablet is the most widely used solid dosage form because of its convenience in term of self-administration, compactness, accurate dosage and ease in manufacturing.[1]

- Therefore, many attempts are made to formulate most chemical entities under development as solid dosage forms that also guarantee an effective and reproducible plasma concentration after administration. The main problem associated with oral dosage forms is the difficulty of swallowing mainly for paediatrics, geriatrics, bedridden, and nauseating, or mentally disabled patients.[2]

- Dysphagia, or difficulty in swallowing, 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 and hard gelatin capsule, in the order of frequency of complaints are size, surface, form, and taste of tablets. Geriatric and paediatric patients and traveling patients who may not have ready access to water are most in need of easy swallowing dosage forms.[3]

- In order to solve this problem and improve patient acceptance and compliance, the development of solid dosage forms that disintegrate rapidly or dissolve even when taken orally without water is being undertaken. Oral fast-disintegrating dosage forms (tablet or a capsule) are a relatively novel dosage technology that involves the rapid disintegration or dissolution of the dosage form into a solution or suspension in the mouth without the need for water. The dosage form begins to disintegrate immediately after coming into contact with saliva, with complete disintegration normally occurring within 30–50 s after administration. The solution containing the active ingredients is swallowed, and the active ingredients are then absorbed through the gastrointestinal epithelium to reach the target and produce the desired effect. The faster the drug into solution form, quicker the absorption and onset of clinical effects.[4]

- The United States Food and Drug Administration defines ODT as "a solid dosage form containing medicinal substance or active ingredient which disintegrates rapidly usually within a matter of seconds when placed upon the tongue." The disintegration time for ODTs generally ranges from several seconds to about a minute. The drug is being absorbed from mouth, pharynx and oesophagus as the saliva passes down into the stomach. A fraction of pregastric drug absorption may bypass the digestive system and metabolism by the stomach acids and enzymes. In such cases bioavailability of drug is significantly greater than those observed from conventional tablet dosage form. Recently, the European Pharmacopoeia has used the term

orodispersible tablets for tablets that disperse readily and within 3 minutes in the mouth before swallowing.[5]

- Orally disintegrating tablets are also called as orodispersible tablets, quick disintegrating tablets, mouth dissolving tablets, fast disintegrating tablets, fast dissolving tablets, rapid dissolving tablets, porous tablets, and rapid melts. However, of all the above terms, United States pharmacopoeia (USP) approved these dosage forms as ODTs.[6]

ADVANTAGES OF ODT'S

- ODT can be administered to the patients who cannot swallow tablets/capsules., such as the elderly, stroke victims, bedridden patients, patients with oesophageal problems & patients who refuse to swallow such as paediatric, geriatric & psychiatric patients and thus improves patient compliance.
- ODT opened new business opportunity like product differentiation, product promotion, patent extension and life cycle management.
- Cost effective.
- Rapid drug therapy intervention.
- Adaptable and amenable to existing processing and packaging machinery.[7]
- It contains the certain studies which concluded increased bioavailability and proved rapid absorption of drugs through pregastric absorption of drugs from mouth, pharynx & oesophagus as saliva passes down.
- ODT is the most convenient for travellers and busy people, who do not always have access to water.
- No chewing needed.[8]
- Good mouth feel property of ODT helps to change the perception of medication.
- Good chemical stability as conventional oral solid dosage form.
- Provides rapid drug delivery from dosage forms.[9]
- The risk of chocking or suffocation during oral administration of conventional formulations due to physical obstruction is avoided, thus providing improved safety.[10]
- No specific packaging required can be packaged in push through blisters.
- Conventional manufacturing equipment.[11]
- Rapid onset of action.
- Provide advantage of liquid medication in form of solid preparation.[12]
- Beneficial in cases such as motion sickness (kinetosis), sudden episodes of allergic attack or coughing, where an ultra-rapid onset of action required.
- Pre-gastric absorption can result in reduced dose and improved clinical performance by reducing side effects.[13]
- Pre-gastric absorption also prevents the first-pass effect and provides a significant advantage for the drug subject to hepatic metabolism.[14]

APPROACHES/TECHNIQUES TO PREPARE ODT'S

- Various preparation techniques have been developed on the basis of different principles, thus present different properties of ODTs by means of mechanical strength, stability, mouth feel, taste, swallowability, dissolution profile and bioavailability. Some of those technologies are patented.

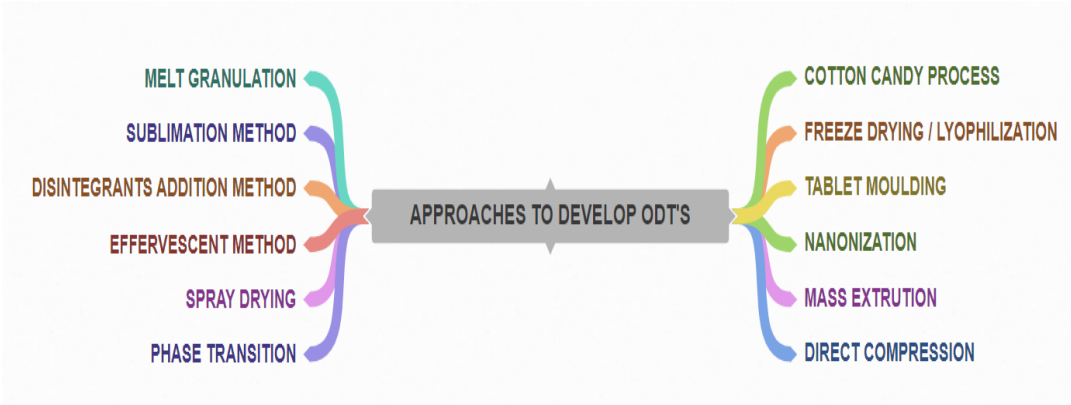

Fig 1: Various approaches used to develop ODT'S.

A) SUPERDISINTEGRANT ADDITION METHOD

- Use of disintegrants is the basic approach in development of ODTs.
- Disintegrants play a major role in the disintegration and dissolution of ODT.
- It is essential to choose a suitable disintegrant, in an optimum concentration so as to ensure quick disintegration and high dissolution rates. The optimum concentration of the superdisintegrant can be selected according to critical concentration of disintegrant.[15]
- Disintegrating agents are substances routinely included in the tablet formulations to aid in the break-up of the compacted mass into the primary

particles to facilitate the dissolution or release of the active ingredients when it is put into a fluid environment. They endorse moisture penetration and dispersion of the tablet matrix. The major function of disintegrants is to oppose the efficiency of the tablet binder and physical forces that act under compression to structure the tablet.

- Recently new materials termed as "superdisintegrants" have been developed to improve the disintegration processes. Superdisintegrants are another version of super-absorbing material with tailor-made swelling properties. These materials are not planned to absorb significant amounts of water or aqueous fluids, but planned to swell very fast. Superdisintegrants are used as a structural weakener for the disintegrable solid dosage forms. They are physically dispersed within the matrix of the dosage form and will expand when the dosage form is exposed to the wet environment.
- These newer substances are more effective at lower concentrations with greater disintegrating efficiency and mechanical strength.
- Superdisintegrants are generally used at a low level in the solid dosage form, typically 1 - 10 % by weight relative to the total weight of the dosage unit. Their particles are generally small and porous, which allow for rapid tablet disintegration in the mouth without an objectionable mouth-feel from either large particles or gelling. The particles are also compressible which improves tablet hardness and its friability.
- Effective superdisintegrants provide improved compressibility, compatibility and have no negative impact on the mechanical strength of formulations containing high-dose drugs. Generally, one gram of superdisintegrant absorbs 10-40 g of water or aqueous medium. After absorption, swelling pressure and isotropic swelling of the superdisintegrants particles create stress concentrated areas where a gradient of mechanical properties will exist due to which whole structure will break apart.[16]

SELECTION OF SUPERDISINTEGRANTS

- Since superdisintegrant is used as an excipient in the tablet formulation, it has to meet certain criteria other than its swelling properties. The requirement placed on the tablet disintegrant should be clearly defined. The ideal disintegrant should have –

1. Poor solubility
2. Poor gel formation
3. Good hydration capacity
4. Good moulding and flow properties
5. No tendency to form complexes with the drugs
6. Good mouth feel
7. It should also be compatible with the other excipients and have desirable tableting properties [17,18]

METHODS OF INCORPORATING DISINTEGRANTS INTO TABLETS

Fig 2: Various methods to incorporate disintegrants into tablets.

1. Internal Addition (Intragranular) - In Internal addition method, the disintegrant is mixed with other powders before wetting the powder mixtures with the granulating fluid. Thus, the disintegrant is incorporated within the granules.

2. External Addition (Extragranular) - In external addition method, the disintegrant is added to the sized granulation with mixing prior to compression.

3. Partly Internal and External- In this method, part of disintegrant can be added internally and part externally. This results in immediate disruption of the tablet into previously compressed granules while the disintegrating agent within the granules produces additional erosion of the granules to the original powder particles. The two-step method usually produces better and more complete disintegration than the usual method of adding the disintegrant to the granulation surface only [19,20].

MECHANISM OF SUPERDISINTEGRANTS [21,22,23,24,25]

- Superdisintegrants are used to improve the efficacy of solid dosage forms. This is achieved by various mechanisms. The mechanism by which the tablets are broken into small pieces and then produces a homogeneous suspension is based on:

1. Swelling
2. Porosity and capillary action (Wicking)
3. Heat of wetting
4. Chemical reaction (Acid-Base reaction)
5. Particle repulsive forces
6. Deformation recovery
7. Enzymatic reaction

TABLE 1: Various mechanism of action of superdisintegrants.

S.NO	MECHANISM	THEORY
1.	Swelling	• Although water penetration is a necessary first step for disintegration, swelling is probably the most widely accepted mechanism of action for tablet disintegrants. • Particles of disintegrants swell on coming in contact with suitable medium and a swelling force develops which leads to break-up of the matrix. • Tablets with high porosity show poor disintegration due to lack of adequate swelling force. • On the other hand, sufficient swelling force is exerted in the tablet with low porosity. • It is worthwhile to note that if the packing fraction is very high, fluid is unable to penetrate in the tablet and disintegration is again slows down.
2.	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. • When we put the tablet into suitable aqueous medium, the medium penetrates into the tablet and replaces the air adsorbed on the particles, which weakens the intermolecular bond and breaks the tablet into fine particles. • Water uptake by tablet depends upon hydrophilicity of the drug/excipient and on tableting conditions. • For these types of disintegrants maintenance of porous structure and low interfacial tension towards aqueous fluid is necessary which helps in disintegration by creating a hydrophilic network around the drug particles.
3.	Heat of wetting	• When disintegrants with exothermic properties get wetted, localized stress is created due to capillary air expansion, which aids in disintegration of tablet. • This explanation, however, is limited to only a few types of disintegrants and cannot describe the action of most modern disintegrating agents.
4.	Chemical reaction (Acid-Base reaction)	• The tablet is quickly broken apart by internal liberation of CO2 in water due to interaction between tartaric acid and citric acid (acids) with alkali metal carbonates or bicarbonates (bases) in presence of water. • The tablet disintegrates due to generation of pressure within the tablet. Due to liberation in CO2 gas, the dissolution of active pharmaceutical ingredients in water as well as taste masking effect is enhanced. • As these disintegrants are highly sensitive to small changes in humidity level and temperature, strict control of environment is required during preparation of the tablets. • The effervescent blend is either added immediately prior to compression or can be added in two separate fractions of formulation.
5.	Particle repulsive forces	• This is another mechanism of disintegration that attempts to explain the swelling of tablet made with non-swellable disintegrants. • According to Guyot-Hermann's particle-particle repulsion theory, water penetrates into tablet through hydrophilic pores and a continuous starch network is created that can convey water from one particle to the next, imparting a significant hydrostatic pressure. • The water then penetrates between starch grains because of its affinity for starch surfaces, thereby breaking hydrogen bonds and other forces holding the tablet together. • The electric repulsive forces between particles are the mechanism of disintegration and water is required for it.

6.	Deformation recovery	• Deformation recovery theory implies that the shape of disintegrant particles is distorted during compression and the particles return to their pre-compression shape upon wetting, thereby this increase in size of the deformed particles causing the tablet to break apart. • Such a phenomenon may be an important aspect of the mechanism of action of disintegrants such as Crospovidone and starch that exhibit little or no swelling.
7.	Enzymatic reaction	• Enzymes present in the body also act as disintegrants. These enzymes dearth the binding action of binder and helps in Disintegration. • Due to swelling, pressure is exerted in the outer direction that causes the tablet to burst or the accelerated absorption of water leads to an enormous increase in the volume of granules to promote disintegration.

EXAMPLES

1. Neha Vishal Gandhi *et al*., prepared orodispersible tablets using three different superdisintegrants e.g., sodium starch glycolate, croscarmellose sodium and crospovidone in three different concentrations e.g., 3%, 5% and 7% along with other excipients. The tablets were evaluated and the results compared for all three superdisintegrants revealed crospovidone to be the most efficacious superdisintegrant to formulate orodispersible tablet of naproxen sodium as suggested by the dispersion time, disintegration time and drug dissolution profiles. The formulations containing CP, 7% depicted lowest dispersion time (23.35 seconds), disintegration time (21.50 seconds) and highest % cumulative drug release (98.79%).[26]

2. C Haranath *et al*., formulated oral dispersible tablets of escitalopram by using natural and synthetic superdisintegrants. In this study, natural super disintegrating agent used was dehydrated banana powder and synthetic one is crospovidone. Six formulations were prepared using different concentrations of superdisintegrants like dehydrated banana powder and crospovidone. Formulation containing 10% w/w of dehydrated banana powder has shown disintegration time of 20 sec and 97% of drug release within 25 minutes. The formulation containing 10% w/w of crospovidone has shown disintegration time of 18 sec and 94% of drug release within 20 minutes.[27]

B) EFFERVESCENT METHOD

- Orodispersible tablets are also prepared by effervescent method by mixing sodium bicarbonate and tartaric acid or citric acid of concentration 12% (w/w) along with super disintegrants like pregelatinized starch, sodium starch glycolate, crospovidone, and croscarmellose sodium etc.

- First, sodium bicarbonate and tartaric acid were preheated at a temperature of 80°c to remove absorbed/residual moisture and thoroughly mixed in the motor. Finally, the blends are compressed in the punch.[28]

EXAMPLE

- P.V. Swamy *et al.*, designed orodispersible tablets of pheniramine maleate with a view to enhance patient compliance by effervescent method. In the effervescent method, mixture of sodium bicarbonate and tartaric acid (each of 12% w/w concentration) were used along with super disintegrants, i.e., pregelatinized starch, sodium starch glycolate, croscarmellose sodium and crospovidone. Formulation containing 4% w/w crospovidone and mixture of sodium bicarbonate and tartaric acid (each of 12% w/w) emerged as the overall best formulation with 70% drug dissolution within 1.65min.[29]

C) SUBLIMATION

- The basis of this technique is to add inert solid ingredients that volatilize readily, (e.g., camphor, ammonium bicarbonate, naphthalene, urea, urethane etc) to other tablet excipients and the mixture is then compressed into tablets. Volatile material is then removed via sublimation, which generate a porous structure. Mannitol and camphor were used as a tablet matrix material and subliming the material respectively. Camphor was iminated by subliming in vacuum at 80°C for 30 minutes to develop pores in the tablets.[30]

EXAMPLE

- Kalyankar P *et al.*, formulate directly compressible orodispersible tablets of quetiapine fumarate by sublimation method with a view to enhance patient compliance. A full 3^2 factorial design was used to investigate the effect of two variables *viz*., concentration of Indion 414 and camphor. Indion 414 (3-5 % w/w) was used as superdisintegrant and camphor (5-15 % w/w) as subliming agent.

- The formulation containing 5% w/w of Indion 414 and 5% w/w camphor was emerged as promising based on evaluation parameters. The disintegration time for optimized formulation was 18.66 s. The directly compressible orodispersible tablets of quetiapine fumarate with lower friability, greater drug release and shorter disintegration times were obtained using Indion 414 and camphor at optimum concentrations.[31]

D) DIRECT COMPRESSION

- The basic principle of this technique is addition of superdisintegrants in optimum concentrations to tablet formulation in which powdered blend compress directly to form tablets.[32]

EXAMPLE

- R.B. Nawale *et al.*, formulated Orodispersible Tablet (ODT) of BCS class II drug Domperidone using Kyron T-314 as superdisintegrant and Avicel 102 as disintegrant by direct compression method. A 3^2 factorial design was used to investigate effect of independent variables viz. superdisintegrant (Kyron T-314) and disintegrant (Avicel 102) on dependent responses like friability, disintegration time and percent drug release. Sodium lauryl sulphate (SLS) was used in the formulation to aid the dissolution of drug. All the formulations were evaluated for hardness, friability, disintegration time and dissolution rate.

- The factorial batch F4 containing 1.5 mg Kyron T-314 and 5 mg Avicel 102 has shown better results for all evaluation parameters with drug release of 99.22% and disintegration time of 29 sec.[33]

E) MELT GRANULATION

- Melt granulation technique is a process by use of which pharmaceutical powders are efficiently agglomerated by a meltable binder. The advantage of this technique compared to a conventional granulation technique is that no water or organic solvents are required. Because there is no drying step involved, the process is less time consuming and uses less energy than wet granulation.

- It is a useful technique to increase the dissolution rate of poorly water-soluble drugs, such as griseofulvin. This approach to prepare ODT with sufficient mechanical integrity, involves the use of a hydrophilic waxy binder (Superpolystate ©, PEG – 6 – stearate). Superpolystate © is a waxy material with a melting point of 33–37°C and a HLB value of 9. So, it will not only act as a binder and enhance the physical resistance of tablets but will also help the disintegration of the tablets as it melts in the mouth and solubilizes rapidly leaving no residues.[34]

EXAMPLE

- Hari Kuralla *et al.*, formulated and evaluated orally disintegrating taste masked drotaverine hydrochloride (HCl) tablets prepared by the melt granulation technique. Taste-masked drug—polymer melt granules of drotaverine HCl were prepared by using either compritol 888 ATO (compritol) or precirol ATO 5 (precirol) using varying drug-polymer ratios of 1:1, 1:2, 1:5, and 1:7.
- Prepared drug-polymer blends were evaluated for taste masking and the ratio of drug-polymer is optimized. The drug-polymer ratios 1:7 with compritol and 1:5 with precirol were optimized based on taste evaluation. The granules and tablets prepared with optimized drug-polymer ratio were evaluated for pre- and post-compression parameters.

- From all the prepared taste masked drotaverine HCl tablets, formulations CP9 and PF5 were optimized based on taste, mouthfeel, dissolution, and other oral disintegrating tablet (ODT) parameters. Formulations CP9 and PF5 showed the release of >50% drug in 5 minutes and 100% of the drug in 45 and 30 minutes, respectively. The present melt granulation technique can be effectively used for taste masking [35].

F) FREEZE DRYING / LYOPHILIZATION

- Lyophilization means drying at low temperature under condition that involves the removal of water by sublimation. Drug in a water-soluble matrix which is then freeze dried to give highly porous structure. The tablets prepared by lyophilization disintegrate rapidly in less than 5 seconds due to quick penetration of saliva in pores when placed in the oral cavity. Lyophilization is useful for heat sensitive drugs i.e., thermo-labile substances.

- Freeze drying process normally consists of three steps:
  - Material is frozen to bring it below the eutectic point.
  - Primary drying to reduce the moisture around 4% w/w of dry product.
  - Secondary drying to reduce the bound moisture up to required final volume.

EXAMPLE

- Hitendra S Mahajan *et al.*, prepared ODT'S by lyophilizing an aqueous dispersion of tadalafil containing modified pea starch. ODTs were investigated for tablet characteristics including dimensions, hardness, friability, in vitro dissolution and in vitro/in vivo disintegration time. The best properties exhibited by OTD are wetting time 13.5± 1.2sec, disintegration time of 16.6 ± 0.8 sec. Results obtained from dissolution studies showed that ODT of tadalafil significantly improved the dissolution rate of the drug compared with the native drug. More than 75% of tadalafil in ODT dissolved within 1 min compared to only 30% of tadalafil native drug dissolved during 60 sec.[37]

G) SPRAY DRYING

- This technique is based on a particulate support matrix, which is prepared by spray drying an aqueous composition containing support matrix and other components to form a highly porous and fine powder. This then mixed with active ingredients and compressed into tablets. The formulations are incorporated by hydrolysed and non-hydrolysed gelatins as supporting agents, mannitol as bulking

agent, sodium starch glycolate or croscarmellose sodium as disintegrating and an acidic material (e.g., citric acid) and / or alkali material (e.g., sodium bicarbonate) to enhance disintegration and dissolution. Tablet compressed from the spray dried powder disintegrated within 20 seconds when immersed in an aqueous medium.[38]

EXAMPLE

- Dr. Shailesh T. Prajapati *et al.,* formulated and evaluated orodispersible tablets of cilnidipine by spray drying technique. Diverse water-soluble carriers viz. Polyethylene glycols (PEG 4000, 6000), Hydroxypropyl Methyl cellulose (HPMC E5 LV), Chitosan, Carrageenan, Poloxamer 188, Sodium CMC and β-cyclodextrin were used for this purpose. Spray drying of Cilnidipine with PVP K30 and Sodium CMC in order to determine the potential effect on solubility Cilnidipine.

- The solid-state interactions of the spray dried mixtures were evaluated by DSC. Results show that increase in solubility was achieved for Cilnidipine by preparing spray dried dispersion using PVP K30 in ratio of (1:1) with pure drug. Optimized formulation was further compressed into as orodispersible tablet by direct compression method.

- The prepared tablets were evaluated for the drug content, weight variation, wetting time, in vitro disintegration, hardness, friability, thickness and in vitro dissolution. Results revealed that Kyron T314 showed least disintegration time compare other disintegrant. Hence spray drying technique can be used for formulation of tablets of Cilnidipine by direct compression technique.[39]

H) PHASE TRANSITION

- FDT were produced by compressing powder containing erythritol (melting point:122 °C) and xylitol (melting point: 93 95 °C), and then heating at about 93 °C for 15 min. After heating, the median pore size of the tablets was increased and tablet hardness was also increased. The increase of tablet hardness with heating and storage did not depend on the crystal state of the lower melting point sugar alcohol.[40]

I) COTTON CANDY PROCESS

- This process utilizes a unique spinning mechanism to produce floss-like crystalline structure. Cotton candy process involves formation of matrix of polysaccharides or saccharides by simultaneous action of flash melting and spinning. The matrix formed is partially recrystallized to improve flow property and compressibility. This candy floss matrix is then milled and blended with active ingredients and excipients and subsequently compressed to orally disintegrating tablet. This process can accommodate larger drug doses and offers improved mechanical strength. However, high-process temperature limits the use of this process.[41]

J) MASS EXTRUTION

- This technology involves softening the active blend using the solvent mixture of water-soluble polyethylene glycol, using methanol and expulsion of softened mass through the extruder or syringe to get a cylinder of the product into even segments using heated blade to form tablets. The dried cylinder can also be used to coat granules of bitter tasting drugs and thereby masking their bitter taste.[42]

K) TABLET MOULDING[43]

- Moulding process includes moistening, dissolving, or dispersing the drug with a solvent then moulding the moist mixture into tablets (compression moulding with lower pressure than conventional tablet compression), evaporating the solvent from drug solution, or suspension at ambient pressure (no vacuum lyophilisation), respectively. The moulded tablets formed by compression moulding are air-dried.

- As the compression force employed is lower than conventional tablets, the moulded tablet results in highly porous structure, which increases the disintegration and dissolution rate of the product.

- However, to further improve dissolution rate of the product powder mixture should be sieved through very fine screen. As moulding process is employed usually with soluble ingredients (saccharides) which offers improved mouth feel and disintegration of tablets.

- However, moulded tablets have low mechanical strength, which results in erosion and breakage during handling.

- Different moulding techniques can be used to prepare mouth-dissolving tablets.

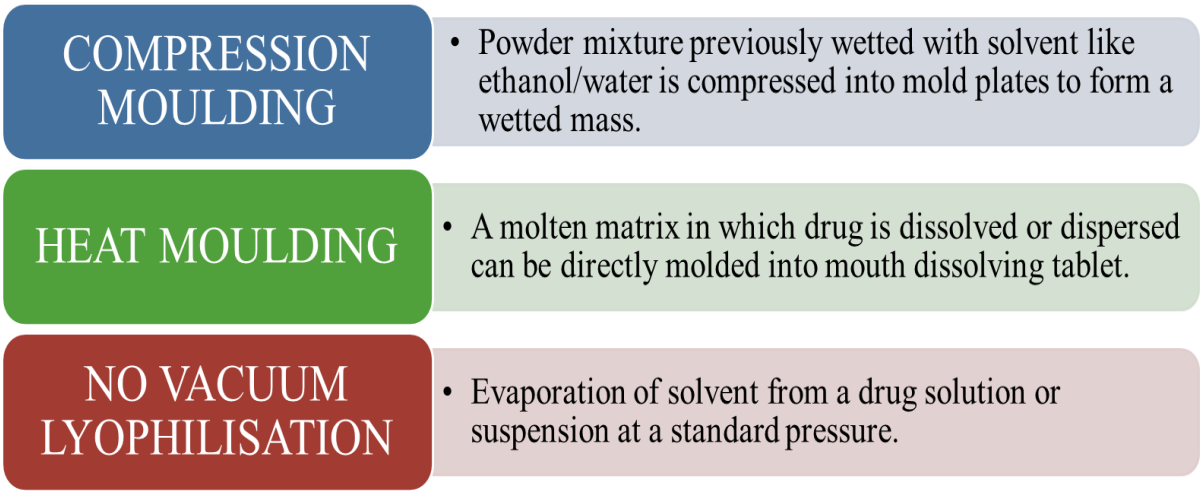

Fig 3: Different moulding techniques.

L)NANONIZATION

- A recently developed Nanomelt technology involves reduction in the particle size of drug to nanosize by milling the drug using a proprietary wet-milling technique. The nanocrystals of the drug are stabilized against agglomeration by surface adsorption on selected stabilizers, which are then incorporated into MDTs. This technique is especially advantageous for poorly water-soluble drugs. Other advantages of this technology include fast disintegration/dissolution of nanoparticles leading to increased absorption and hence higher bioavailability and reduction in dose, cost effective manufacturing process, conventional packaging due to exceptional durability and wide range of doses (up to 200 mg of drug per unit).[44]

CONVENTIONAL TECHNIQUES AND THEIR CHARACTERISTICS[45]

TABLE 2: Various conventional techniques and their characteristics.

S.NO	TECHNIQUES	CHARACTERISTICS
1.	Disintegrant addition	Similar to conventional tablets with higher % of disintegrants, lower hardness and higher % of friability
2.	Freeze Drying or Lyophilization	The preparations are highly porous, have high specific surface area, dissolve rapidly and ultimately show improved absorption and bioavailability
3.	Moulding	Moulded tablets are very less compact than compressed tablet porous structure that enhances disintegration/dissolution and finally absorption increased.
4.	Sublimation	Porous structure that enhances dissolution by using volatile material or solvent e.g. cyclohexane, benzene etc.
5.	Spray-Drying	Prepared tablet disintegrates within 20 seconds when immersed in an aqueous medium
6.	Mass Extrusion	The dried product can be used to coat granules of bitter tasting drugs and thereby masking their bitter taste.
7.	Direct compression	It is most cost-effective tablet manufacturing technique.
8.	Cotton candy process	It can accommodate high doses of drug and offers improved mechanical strength.
9.	Compaction a) Melt granulation b) Phase transition process	 It melts in the mouth and solubilizes rapidly leaving no residue. The compatibility increased and so sufficient hardness gained by the formulation.
10.	Nanonization	It is used for poorly water-soluble drugs. It leads to higher bioavailability and reduction in dose, cost effective manufacturing process.

PATENTED TECHNOLOGIES[46,47]

TABLE 3: Patented technologies and their approaches.

PATENTED TECHNOLOGY	BASED ON
ZYDIS	Porous matrix
QUICKSOLV	Lyophilization
LYOC	Freeze drying
FLASHTAB	Tableting with disintegrants and swelling agents
ORASOLV	Tableting with effervescent disintegrants
DURASOLV	Direct compression
DISPERSIBLE TABLET TECHNOLOGY	Direct compression
WOWTAB	Tableting with low and high moldability saccharides
ZIPLETS	Tableting with water in soluble ingredient and effective disintegrants
ADVATAB	Microcaps and diffuscap CR Technology
FLASHDOSE	Cotton Candy Process
SHEAFORM TECHNOLOGY	Cotton Candy Process
ORAQUICK	Micromask taste Masking
NANOCRYSTAL	On decreasing the particle size, surface area will increase, this leads to an increase in dissolution rate
FROSTA	Highly plastic granules are compressed at low pressure to produce strong tablets with high porosity
CEFORM TECHNOLOGY	Microspheres and compression

CONCLUSION

- The ODTs have potential advantages over conventional dosage forms, with their improved patient compliance, convenience, bioavailability and rapid onset of action had drawn the attention of many manufactures over a decade.

- All the available ODTs technologies/approaches work on the primary concept, to maximize the porous structure of the tablet matrix to achieve speedy tablet disintegration in the buccal cavity along with good taste-masking properties and satisfactory mechanical strength.

- Future challenges for many ODT manufacturers include reducing costs by finding ways to manufacture with conventional equipment, varieties in packaging, enhanced mechanical strength and taste-masking potential. Hence, demand by patients and the accessibility of various technologies have increased the acceptance of oral disintegrating tablets, which in turn prolongs the patent life of a drug.

- The techniques and technologies described in this article represent how recent developments in formulation and processing technologies make the efforts to achieve orodispersible tablets. One can consider the emergence of more novel technologies for ODTs in the coming days. Thus, ODTs will have tremendous scope as a delivery system for most of the drugs in the near future.

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