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FAST DISSOLVING DRUG DELIVERY SYSTEM: REVIEW

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ABSTRACT

The oral route is the most convenient route for administration of solid dosage form, about 85% of solid dosage administered by oral route because of advantages over others. The therapeutic activity of these formulations is obtained through a typical manner like disintegration followed by dissolution. Hence disintegration has major role for facilitating drug activity. The Fast dissolving drug delivery system (FDDS) technologies brings valuable benefits to patients, life cycles and profits. The objective of the present article is to highlight the various kinds of superdisintegrants along with their role in tablet disintegration and drug release, which are being used in the formulation to provide the safer, effective drug delivery with patient compliance. This review focuses on various synthetic superdisintegrants, natural superdisintegrants from different plant sources. In this article includes requirement for fast dissolving drug delivery system, their advantages, selection of superdisinegrant, various technologies, mechanisms of superdisintegrant, types of superdisintegrant.

KEYWORDS: Fast disintegrating tablets, Superdisinegrants, Oral route, Methods.

INTRODUCTION[1,2]

Oral drug delivery remains the preferred route for administration of various drugs acceptance up to 50-60% of total dosage forms. Solid dosage forms are popular because of ease of administration, accurate dosage, self-medication, pain avoidance and most importantly the patient compliance. The most popular solid dosage forms are being tablets and capsules; one important drawback of this dosage forms for some patients is the difficulty to swallow. Drinking water plays an important role in the swallowing of oral dosage forms. Often times

people experience inconvenience in swallowing conventional dosage forms such as tablet when water is not available, in the case of the motion sickness (kinetosis) and sudden episodes of coughing during the common cold, allergic condition and bronchitis. For these reasons, tablets that can rapidly dissolve or disintegrate in the oral cavity have attracted a great deal of attention. The problem of swallowing is a common phenomenon in a geriatric patient due to fear of choking, hand tremors, dysphasia and in young individuals due to underdeveloped muscular and nervous systems and in schizophrenic patients which leads to poor patient compliance. Approximately one-third of the population (mainly pediatric and geriatric) has swallowing difficulties, resulting in poor compliance with oral tablet drug therapy which leads to reduced overall therapy effectiveness. For these reasons, tablets that can rapidly dissolve or disintegrate in the oral cavity have attracted a great deal of attention.

1.1 Fast dissolving drug delivery system[3,4,5,6]

The concept of Fast dissolving tablets emerges as one of the popular and widely accepted dosage forms, especially for elderly and pediatrics patients are quite unable to swallow (Dysphagia) is a common problem of all age groups patients. The most popular solid dosage form is tablets and capsules, one important drawback of this dosage forms for some patient's difficulty in swallow. Fast dissolving drug delivery system are the tablets that disintegrates and dissolves in the oral cavity and the saliva without the need of water or chewing. Fast dissolving tablets are dissolve within a few seconds. Fast dissolving drug delivery systems have popular and accepted drug delivery systems, because they are easy to administer and lead to better patient compliance. Pharmaceutical technologists have developed a novel oral dosage forms known as Fast disintegrating (dissolving) tablets (FDTs) or orally disintegrating (dispersible) tablets (ODTs) or Fast disintegrating (dissolving) tablets (FDTs) or mouth dissolving tablets (MDTs) or mouth melting tablets (MMTs), immediate release tablets. FDTs formulations contain super disintegrates like croscarmellose sodium, sodium starch glycolate and crospovidone to enhance the disintegration rate of a tablet in the oral cavity.

1.1.1 Definition[7,8]

- ✓ European pharmacopeia defined "orodispersible tablet as a tablet that is to be placed in the mouth where it disperses rapidly before swallowing".
- ✓ United States Food and Drug Administration (USFDA) defined fast dissolving tablet (FDT) as "A solid dosage form containing a medicinal substance or active ingredient

which disintegrate rapidly usually within a matter of seconds when placed upon the tongue".

1.2 Advantages of fast dissolving tablets[9,10]

- Suitable for sustained/controlled release actives.
- Ease administration for patients who are mentally ill, disabled and uncooperative.
- Accurate dosing as compared to liquids.
- Allows high drug loading.
- First pass metabolism is reduced, thus offering improved bioavailability and thus reduced dose and side effects.
- Dissolution and absorption of the drug is fast, offering rapid onset of action.
- The new proprietary method allows the incorporation of microencapsulated drugs for enhanced bioavailability, flexibility of dosing & immediate and/or controlled release.
- Best alternate to deliver the drug having bitter taste and poor bioavailability.
- Easy manufacturing, accurate dosing, good chemical and physical stability and an ideal alternative for geriatric and pediatric patients.
- Ability to provide advantages of liquid medication in the form of solid preparation.
- Improve patient compliance.
- Administered without water, anywhere, anytime.
- Tablets having great mouth feel due to fast melting effect.

1.3 Selection of Superdisintegrants[11,12]

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.

Although some are better than others, the currently marketed superdisintegrants exhibit an optimum combination of properties. Methods of Incorporating Disintegrants into Tablets 12, 23**:** There are two methods of incorporating disintegrating agents into the tablet as described below:

A. 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.

B. External addition (Extragranular)

In external addition method, the disintegrant is added to the sized granulation with mixing prior to compression.

C. 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.

1.4 Mechanism of superdisintegrant[13,14,15,16,17]

Superdisintegrants provide quick disintegration due to combined effect of swelling and water absorption by the formulation. Due to swelling of superdisintegrants, the wetted surface of the carrier increases, this promotes the wettability and dispersibility of the system, thus enhancing the disintegration and dissolution. The optimum concentration of the superdisintegrant can be selected according to critical concentration of disintegrant. Below this concentration, the tablet disintegration time is inversely proportional to the concentration of the superdisintegrant, whereas if concentration of superdisintegrant is above critical concentration, the disintegration time remains almost constant or even increases. There are major mechanisms for tablet disintegration as follows.

a) Swelling action
b) Porosity and Capillary action (Wicking)
c) Deformation

d) Enzymatic reaction

e) Due to disintegrating particle/particle repulsive forces

a) Swelling action

Swelling is widely accepted mechanism for tablet disintegration. Although water penetration is a necessary first step for disintegration. Particles of disintegrants swelling in contact with water and the suitable medium with adhesiveness of the other ingredient in tablet is overcome causing the tablet to fall apart. 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.

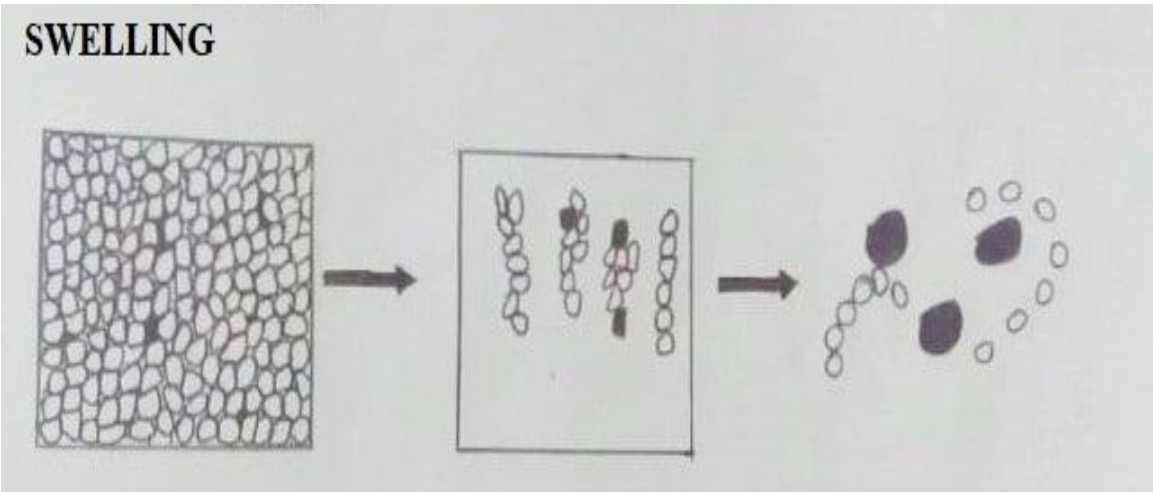

Figure No. 1 Disintegration of tablets by swelling.

b) 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.

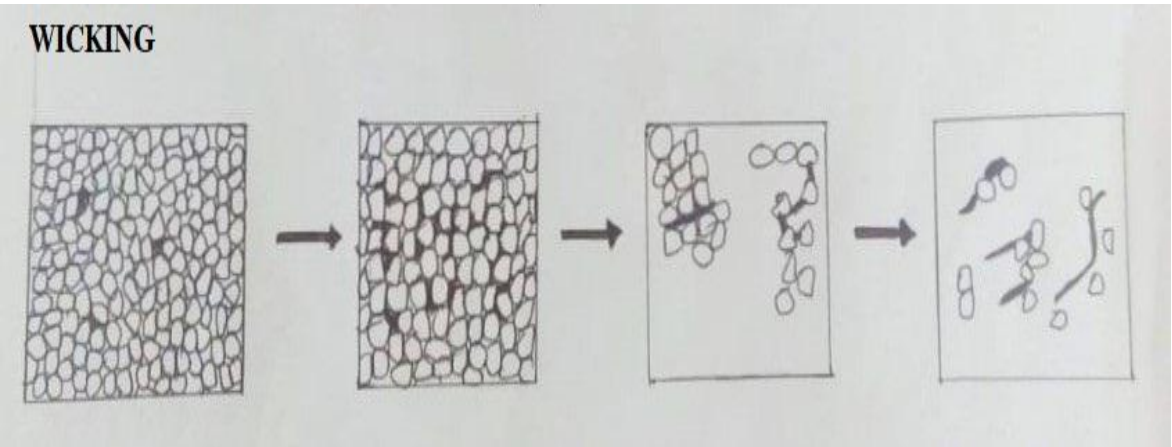

Figure no. 2: Disintegration of tablets by wicking.

c) Deformation

Starch grains are generally thought to be "elastic" in nature meaning that grains (such as potato starch and corn starch) due to high compaction force in case of tableting that are deformed under pressure will return to their original shape when that pressure is removed. But, with the compression forces involved in tableting, these grains are believed to be deformed more permanently and are said to be "energy rich" with this energy being released upon exposure to water. In other words, the ability for starch to swell is higher in "energy rich" starch grains than it is for starch grains that have not been deformed under pressure.

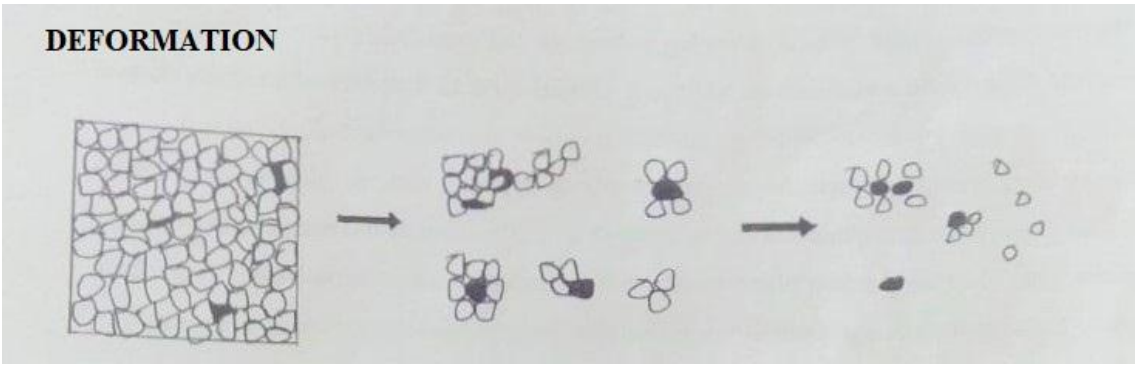

Figure No. 3: Disintegration of tablets by deformation.

d) 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.

Table 1: Some examples of enzymes as disintegrating agent.

Enzyme	Binder
Amylase	Starch
Protease	Gelatin
Cellulase	Cellulose and its derivatives
Invertase	Sucrose

e) Due to disintegrating particle/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. Researcher found that particle repulsion force is secondary to wicking.

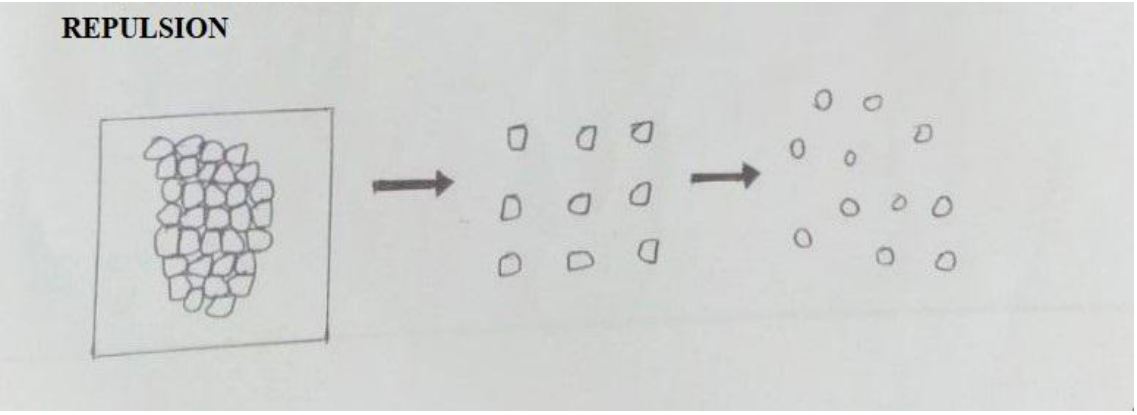

Figure No. 4: Disintegration of tablets by repulsion.

1.5 Type of superdisintegrant and their example[18]

A. Synthetic superdisintegrant

B. Natural superdisintegrant

A. Synthetic superdisintegrant

Synthetic super- disintegrates are frequently used in tablet formulations to improve the rate and extent of tablet disintegration thereby increasing the rate of drug dissolution.

Table 2 Synthetic Superdisintegrants with their Mechanism of Action and Brand Name.

Superdisintegrants	Brand names	Mechanism of action	Special comments
Crosslinked cellulose	Croscarmellose®, Ac-Di-Sol®, Nymce ZSX®, Primellose®, Solutab®, Vivasol®, L-HPC, Nymcel	Swelling and Wicking both	Swelling two dimensions, Direct compression or Granulation starch free.
Crosslinked PVP	Crosspovidone M®, Kollidone®, Polyplasdone®, polyplasdone XL®, Kollidone CL®	Capillary action	Water insoluble and spongy in nature so get porous tablet
Crosslinked Starch	Explotab®, Primogel®, Tablo®, Vivastar®	Swelling	Swells in three dimensions and high level serve as sustain release matrix
Crosslinked alginic acid	Alginic acid NF®, Staialgine®	Swelling or Wicking	Promote disintegration in both dry and wet granulation
Soy polysaccharides	Emcosoy®	-	Does not contain any starch or sugar. Used in nutritional products.

B. Natural superdisintegrant

These super disintegrating agents are natural in origin and are preferred over synthetic substances because they are comparatively cheaper, abundantly available, non-irritating and nontoxic in nature. The natural materials like gums and mucilage's have been extensively used in the field of drug delivery for their easy availability, cost effectiveness, Eco friendliness, emollient and non-irritant nature, non-toxicity, capable of multitude of chemical modifications, potentially degradable and compatible due to natural origin. There are several gums and mucilage's are available which have super-disintegrating activity.

Table 3: Natural Superdisintegrants with their Mechanism of Action and Brand Name.

Superdisintegrants	Brand names	Mechanism of action	Special comments
Gallen Gum	Kilcogel®	-	Natural superdisintegrant
Xanthum Gum	Grindsted®, Xanthum SM®	-	Natural superdisintegrant
Ion Exchange Resin	Indion 414®, Tusion 339®, Amberlite IRP 88®	-	-

CONCLUSION

Fast dissolving drug delivery systems are thus novel drug delivery systems that are formulated to improve patient compliance and improve bioavailability. These formulations are cost effective and provide ease of administration to the pediatric, geriatric and such patients that feel difficulty in swallowing.

REFERENCES

1. Bhowmik D, Chiranjib B, Krishnakanth, Pankaj, Chandira RM. Fast dissolving tablet: an overview. J Chem Pharm Res, 2009; 1: 163-77.
2. Siddiqui N, Garg G, Sharma PK. Fast dissolving tablets: preparation, characterization and evaluation: an overview. Int J Pharm Sci Rev Res, 2010; 2: 87-96.
3. Zade PS, Kawtikwar PS, Sakarkar DM. Formulation, evaluation and optimization of fast dissolving tablet containing tizanidine hydrochloride. Inter J Pharm Tech Res, 2009; 1: 34-42.
4. Ishikawa T, Watanabe Y, Utoquchi N, Matsumoto M. Preparation and evaluation of tablets rapidly disintegrating in saliva containing bitter-taste-masked granules by the compression method. Chem Pharm Bull, 1999; 47: 1451-4.
5. Omaima SA, Mohammed HA, Nagia MA, Ahmed SZ. Formulation and optimization of mouth dissolve tablets containing rofecoxib solid dispersion. AAPS Pharm Sci Tech, 2006; 7: E1-9.
6. Simone S, Peter CS. Fast dispersible ibuprofen tablets. Eur J Pharm Sci, 2002; 15: 295-305.
7. European Pharmacopoeia 5.0, Vol. 1.0, 5th ed, Strasbourg, France, 2005; 628.
8. William R, Ghosh A and Tapashk A. Oral disintegrating tablets: products, Technologies and Development issues, Pharm.technol, 2005; 29(10): 136-150.
9. John C Carter. The role of disintegrants in solid oral dosage form manufacturing. Carter Pharmaceutical Consulting, Inc. Retrieved March, 2002; 25: 2011. from http://www.carterpharma ceutical consulting.com/articles/The-role-of-disintergrants. html.
10. Suresh Bandari K, Rajender Kumar, Mittapalli S and Ramesh Gannu S. Orodispersible tablets: An overview, Asian Journal of Pharmaceutics, 2008; 2(1): 2-11.
11. Omidian H and Park K: Swelling agents and devices in oral drug delivery. Journal of Drug Delivery Science and Technology, 2008; 18(2): 83-93.

12. Iyad R, Mayyas AR, Eftaiha AA and Badwan A: Chitin-silicon dioxide coprecipitate as a novel superdisintegrant. Journal of Pharmaceutical Sciences, 2008; 97(11): 4955-69.
13. Konapure AS, Chaudhari PS, Oswal RJ, Kshirsagar SS, Antre RV and Chorage TV: Mouth dissolving tablets-an innovative technology. International Journal of Applied Biology and Pharmaceutical Technology, 2011; 2(1): 496-503.
14. Pahwa R, Piplani M, Sharma PC, Kaushik D and Nanda S: Orally disintegrating tablets – friendly to pediatrics and geriatrics. Archives of Applied Science Research, 2010; 2(2): 35-48.
15. Bhowmik D, Chiranjib B, Yadav J, Chandira RM and Kumar S: Emerging trends of disintegrants used in formulation of solid dosage form. Scholars Research Library Der Pharmacia Lettre, 2010; 2(1): 495-504.
16. Mohanachandran PS, Sindhumol PG and Kiran TS: Superdisintegrants: an overview. Journal of Pharmaceutical Sciences Review and Research, 2011; 6(1): 105-109.
17. Chaudhary SA, Chaudhary AB and Mehta TA: Excipients updates for orally disintegrating dosage forms. International Journal of Research in Pharmaceutical Sciences 2010; 1(2): 103-207.
18. Dhiraj A. Khairnar, Sanjay P. Anantwar, Chetan S. Chaudhari, Pravin A. Shelke, Superdisintegrants: An emerging paradigm in orodispersible tablets, International Journal of Biopharmaceutics 2014; 5(2): 119-128.