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IMPORTANCE OF SUPER DISINTEGRATING AGENTS IN FAST DISSOLVING TABLETS

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ABSTRACT

Over the past few decades, there has been an increasing demand for oral disintegrating tablets, which are an emerging trend in innovative drug delivery systems. Solid dose forms are made more effective by the use of super disintegrants. This is accomplished by lowering the disintegration time, which raises the pace at which drugs dissolve. Disintegrants are compounds or mixtures of substances that are added to the medicine formulation to help the content of tablets or capsules break up or disintegrate into tiny particles that dissolve more quickly than they would if disintegrants weren't present. Superdisintegrants, a class of more modern agents, have been developed in recent years. Super disintegrants fall into a variety of categories, including natural, co processed, synthetic, and semi-synthetic mixes, have been used to create effective mouth-dispersing tablets and get beyond the restrictions of traditional tablet dose forms. Super disintegrants are often employed in solid dosage form at modest levels, approximately 1–10% by weight in relation to the dosage unit's total weight. This study includes all the information available on super disintegrants, such as their types, mechanisms, selection criteria, optimal features, incorporation techniques, and advantages. These super disintegrants are employed in formulations to give safer, more effective drug delivery while maintaining patient compliance.

KeyWords:- Super disintegrants, patient compliance, semi synthetic mixes, Drug delivery system

INTRODUCTION

Because of its many benefits—such as ease of administration, accurate dosage, self-medication, adaptability, and most crucially, patient compliance—oral medicine administration is still the method of choice. Oral solid dose formulations are therefore more often used. Fast-acting dissolving tablets (FDTs) are solid, single-unit dosage forms that dissolve in saliva without the need for water when taken orally. They have a rapid onset of action.

Certain medications are taken up by the mouth, throat, and oesophagus and then passed down into the stomach along with saliva. In these situations, the drug's bioavailability is noticeably higher than that of standard tablet dose forms.[5]"A solid dosage form containing medicinal substance or active ingredient which disintegrates rapidly, usually within a matter of seconds, when placed upon the tongue" is how the US Food and Drug Administration (FDA) defines FDT. For FDTs, the disintegration time typically varies from a few seconds to approximately one minute. Certain medications may have a higher bioavailability because of oral drug absorption as well as pre-gastric absorption of saliva that contains scattered medication and travels down into the stomach. Additionally, compared to conventional tablets, there is a decrease in the amount of medication that is exposed to first pass metabolism [1-7]

ADVANTAGES OF FAST DISOLVING TABLET [8-9]

- Water is not required for swallowing the tablet.
- Patients with mental disabilities, the elderly, and children can all get FDTs with ease.

- Precise dosage in contrast to liquids.
- The medication dissolves and absorbs quickly, providing a quick start to action.
- Drug bioavailability is enhanced because certain medications are absorbed by the mouth, throat, and esophagus and enter the stomach through saliva.
- Better in terms of transportation and administration than liquid medications.
- There is a decrease in first pass metabolism, which improves bioavailability and lowers dosage and side effects.
- Providing increased security.

LIMITATIONS OF FDTS [10-11]

The major disadvantages of FDTs are related to the mechanical strength of tablets.

- FDT are soft, molded metrics that are extremely porous and compressible, making them fragile and friable to handle in tablets with low compression.
- It is challenging to construct medications with bad tastes like FDT; extra care must be taken when preparing such a medication.
- A number of FDT are hygroscopic, meaning they need a particular packing in order to maintain their physical integrity under normal humidity conditions.
- Tablet formulations that cause dry mouth from reduced saliva production might not be the best choice.
- The total bioavailability and the rate of absorption from the saliva solution.
- Stability of drugs and dose forms.

REQUIREMENTS OF FAST DISSOLVING TABLETS

PATIENT FACTORS [12]

Patients (especially young and elderly patients) who have difficulty swallowing regular tablets and capsules can consider fast-dissolving dose forms together with an 8-ounce glass of water. Among them are the following:

- Individuals who experience difficulties chewing or swallowing solid dose forms.
- Patients who comply because they worry about choking.
- Patients with depression who are really old and may not be able to consume solid dosage forms.
- A patient with allergies who is eight years old wants a more convenient dosing form than antihistamine syrup.
- An elderly patient receiving radiation treatment for breast cancer could feel too queasy to take her H2-blocker.
- A patient with schizophrenia who could attempt to stow a traditional tablet under his or her tongue in order to skip taking an atypical antipsychotic medication as prescribed.
- A patient who experiences chronic nausea, may be on the go, or has limited or no access to water.

EFFECTIVENESS FACTOR [11]

One of these formulations' main claims is a quicker onset of action and increased bioavailability. When a medicine dissolves fast, its dispersion in saliva within the oral cavity might lead to pre-gastric absorption from certain formulations. Many medications are absorbed in the stomach, pharynx, and buccal regions. Pre-gastric absorption can be very advantageous for medications that undergo hepatic metabolism since it prevents first-pass metabolism. Drugs with a substantial fraction of absorption in the oral cavity and pre-gastric regions of the GIT, as well as those that produce significant amounts of toxic metabolites mediated by first-pass liver metabolism and stomach metabolism, may also have superior safety profiles.

MANUFACTURING AND MARKETING FACTORS [13]

It is typical for pharmaceutical companies to create a certain therapeutic entity in a new and enhanced dosage form when a medicine approaches the end of its patent life. A firm can increase market exclusivity, distinct product differentiation, and patent protection by developing a new dosage form. For instance, in response to a generic challenge filed in the United States by Ranbaxy, Eisai Inc. introduced Aricept FDT, a line extension of donepezil for Alzheimer's disease, in Japan in 2004 and in the United States in 2005.

SUPERDISINTEGRANTS [14-16]

The faster disintegrating formulation is becoming more and more in demand as time goes on. Therefore, the pharmacist must create super disintegrants, or disintegrants that are more effective intra granularly 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.

CRITERIA FOR SUPERDISINTEGRANT'S SELECTION

Super disintegrants typically influence the pace of disintegration, but when utilized in excess, they can also change the friability, hardness, and mouth feel of the tablet. Thus, a few ideal variables to take into account while choosing the right superdisintegrants for a certain formulation should be:

- When the pill comes into touch with saliva in the mouth or oral cavity, it will begin to dissolve quickly.
- Have sufficient compactness to generate fewer breakable tablets.
- Provide patients with a comfortable mouth feel. Therefore, it is better to have smaller particle sizes to ensure patient compliance.
- Possess a smooth flow, as this enhances the overall blend's flow properties. [17–18]

THE IDEAL CHARACTERISTICS OF SUPERINTEGRANTS

Outstanding Flow and Compressibility Properties

Good flow powders have a compressibility of between 12% and 16%. The compressibility of crospovidone is significantly higher than that of other superdisintegrants. [19,20,21]

Insufficiency in Solubility

The solubility of an essential component in a tablet composition can have an impact on the rate and mechanism of action of tablet disintegration. In contrast to insoluble components, which typically result in tablets that dissolve quickly, water-soluble compounds are more likely to dissolve than disintegrate.[22]

Inadequate Gel Forming Capacity

Gels can slow down disintegration because the medication must first diffuse through the gel layer before being released into the body. Primo gel is used as a superdisintegrant in tablet production at a concentration of 4-6%.[23]

Hydration capacity

Drugs and other excipients that are hydrophobic and can be adsorbed on disintegrate surfaces have an impact on the degree of hydration and effectiveness of these disintegrates. This problem is believed to be resolved by adding quick disintegrates with a high hydration capacity, which leads to increased dissolution.[24]

Complexation

Slow dissolving may result from the compound formed between cationic medication actives and anionic disintegrants such as primo gel and croscarmellose sodium. Non-ionic polymer crospovidone does not interfere with cationic drug actives to prevent drug release. Polyplasdone XL exhibited a faster rate of dissolution for the model cationic drugs, irrespective of their aqueous solubilities, according to an analysis of the effects of superdisintegrating agents such as croscarmellose sodium, primo gel, and polyplasdone XL on the dissolution actions of various cationic drugs with varying water solubility[25, 26]

SUPERDISINTEGRANTS' ADVANTAGES[27]

- Lump creation is not the outcome of disintegration.
- Compatible with a large variety of excipients and medicinal agents.
- Efficient in compositions that are hydrophilic or hydrophobic.
- Gives the tablet exceptional mechanical strength, making packing and shipping simple.
- Researchers are still searching for novel disintegrants and experimenting with modified natural materials, despite the fact that there are several superdisintegrants that exhibit superior disintegration.

DRAWBACKS OF SUPERDISINTEGRANTS[28]

- Expensive.
- More sensitive and hygroscopic in nature.
- Time-consuming and delicate.

CLASSIFICATION OF SUPERDISINTEGRANTS

NATURAL SUPERDISINEGRANTS USED IN FAST DISSOLVING TABLETS[29]

1. Chitosan and Chitin

The polysaccharide chitin (-(14)-N-acetyl-D-glucosamine) is extracted from the shells of shrimp and crabs. It contains an amino group that is covalently bound to the acetyl group, as opposed to the free amino group found in chitosan. Both the wetting and disintegration times in the oral cavity could be measured using surface free energy. The most well- known natural polysaccharide utilized in the pharmaceutical industry for a variety of purposes is chitosan.

2. Guar gum

Galactomannans, which have a large molecular weight of 50,000–8,000,000, are the main component of guar gum. It is mostly found in nature and is employed in many places as an emulsifier, thickener, and stabilizer. (EU, USA, Japan, Australia, etc.). It is a soluble, free-flowing, neutral polymer made of sugar units that is approved for use in food. The solubility of the tablet matrix, pH, and moisture content have no effect on it. It can appear off-white to tan in alkaline tablets and is not usually pure white. It also tends to get weaker over time.

3. Gum Karaya

Gum karaya is a type of vegetable gum that is exuded by Sterculia trees. Gum cannot be employed as a disintegrant or binder in the formulation of dosage forms due to its high viscosity. Gum karaya's potential as a tablet disintegrant has been investigated. Modified gum karaya has been found to accelerate the disintegration of pills. Gum karaya can be used in place of semi-synthetic and synthetic superdisintegrants that are sold in stores.

4. Locust Bean Gum

Carob bean gum is also known as locust bean gum. It is taken out of the ceretonia siliqua, or carob tree, seeds' endosperm. In many applications, locust bean gum can be utilized as a dissolving agent

and a binder concentrations. Additionally, it has been claimed that locust bean gum possesses bioadhesive and solubility-enhancing qualities. Numerous investigations suggest that locust bean gum has potential use in biotechnology and pharmaceuticals.[30]

CUSTOMIZED SUPER DISINTEGRANTS[31-35]

1. Starch

Starch is a common carbohydrate that comes from potatoes and other sources and is used as a disintegrant in dispersible tablets because of its higher swelling index. Vegetables, seeds, and green plants all contain starch. It serves as a disintegrant, binder, and filler. One of the main hypothesized contributions to its disintegrant activity is swelling, size and form of the starch granules, together with the proportion of the substance of the head components, amylose and amylopectin, are all typical for the species. It is believed that certain carbs are addictive. Starch is one of the earliest and most often used disintegrants due to its promising qualities, which include swelling in nature, the quickest disintegration of tablets, and the start of medicine release. Rapid water retention in the mechanism system causes uniform and quick breakdown, which causes a large rise in granule volume. Medication excipients called disintegrants are added to tablet formulations to help compacted tablets break up into smaller pieces in aqueous solutions. Improved tablet splitting in aqueous solutions enhances the breakdown, absorption, and bioavailability of oral controlled medications.

Cellulose

Cellulose is a plant derivative product like methylcellulose and carboxy methyl cellulose that is utilised as a superdisintegrant based on its ability to store water and swelling capacity.[36] Because of its quick onset of action and ability to be taken without the use of water, cellulose is utilised in the manufacturing of fast dissolving tablets.

MECHANISM OF ACTION OF SUPERDISINTEGRANTS

Mechanism Of Action Of Superdisintegrants

Swelling.

- Porosity and capillary action (wicking).
- Combination action.
- Heat of wetting.
- Deformation.
- Enzymatic reaction.
- Electrostatic repulsion.
- Chemical reaction.

Swelling

Swelling is a commonly acknowledged mechanism that inevitably precedes tablet breakdown. It's a procedure wherein the disintegrating effect is produced by certain disintegrating chemicals, such starch. High porosity tablets disintegrate poorly because there is insufficient swelling force. When disintegrant particles come into touch with water, they swell. This can override the adhesiveness of other pharmaceutical substances in a tablet, causing the tablet to break[30], [37]. Figure 1 illustrates the process of breakdown by swelling.

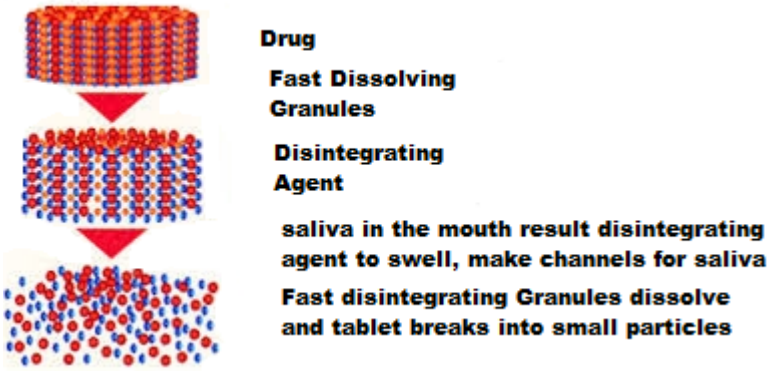

Figure 1: Mechanism of Disintegration through Swelling Action

Capillary Action and Porosity (Wicking)

Disintegrating agents that don't swell work through capillary action and porosity. The tablet's porosity creates channels for liquids to enter tablets. The tablet breaks into fine particles and the intermolecular bond is weakened when it is placed in an appropriate aqueous media, which replaces the air that has been adsorbed on the particles. Tablet water uptake is dependent on tableting circumstances as well as the drug's or excipient's hydrophilicity. Through capillary action, liquid is drawn up or "wicked" into these pathways, breaking the bonds between the particles and causing the tablet to disintegrate. When it comes to various kinds of disintegrants, maintaining porous In order to aid in disintegration, structure and low interfacial tension towards aqueous fluid are essential. This creates a hydrophilic network around the drug particles.

Combined Action

The combination of swelling and wicking action to breakdown in this mechanism.[30.38]
The wicking method of tablet breakdown is depicted in figure: 2.

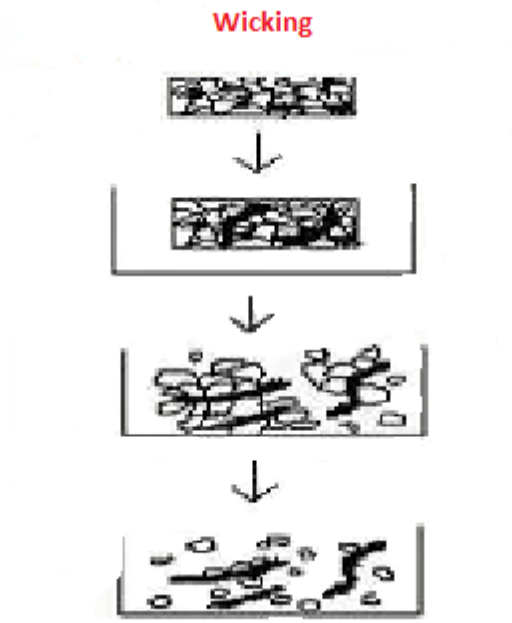

Figure 2: Wicking Mechanism

Temperature of precipitation (Heat of wetting)

Tablet disintegration is aided by capillary air expansion, which occurs when disintegrating agents with exothermic qualities get wetted. While most modern disintegrants cannot be described by this method of action, it does explain the action of some forms of disintegrants[39]

Deformation

When a tablet is compressed, the broken particles become deformed; when they come into touch with water, the deformed particles restore their original shape.

The ability to swell was enhanced during deformation, leading to tablet breakage. Starches (like maize and potato starch) are said to be elastic by nature, but when they are tabled, they cause a lot of compaction force, which causes the elasticity of the grains to deform under pressure to return to its original shape when the pressure is released. These tablets will disintegrate when exposed to an aqueous environment because of the distorted starch grain's energy potential.[40,41]

The disintegration by deformation mechanism displayed in figure: 3

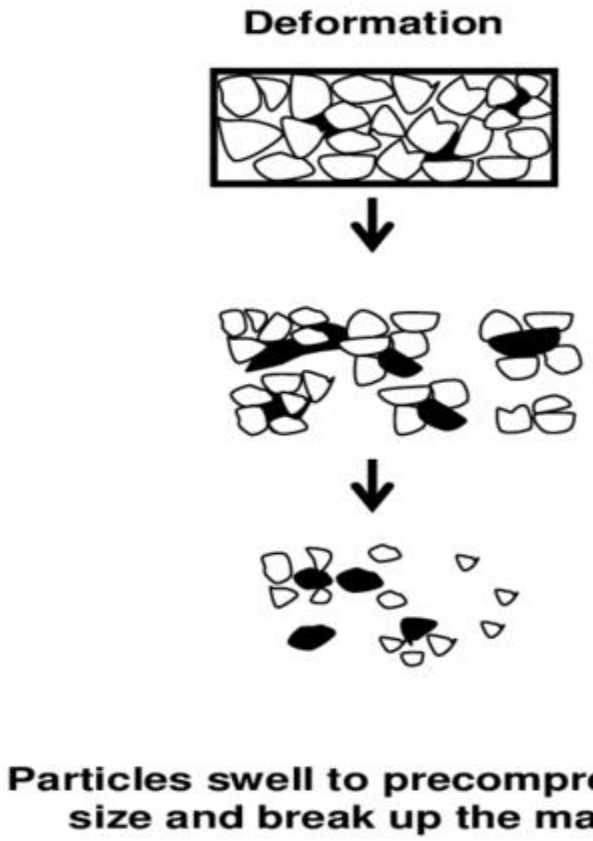

Figure 3: Deformation Mechanism

The action of enzymes

Body's own enzymes also function as disintegrants. These enzymes aid in disintegration by acting on the binder's binding action. The tablet breaks or bursts because of pressure applied in an exterior direction due to swelling. Because of the rapid absorption of water, the amount of granules increases dramatically, causing the tablet to break and increasing the rate of water absorption. This process is known as disintegration, or swelling.[38, 42]

METHOD OF ADDITION OF SUPERDISINTEGRANTS

Three approaches are available for adding super disintegrants to the tablet.

1. Internal Addition

The disintegrant is combined with additional excipients in the wet granulation procedure prior to the powder being soaked in the granulating solution. The disintegrant is therefore integrated into the granules. The disintegrant is combined with additional excipients in the dry granulation process prior to compressing the powder between rollers. The effects of adding croscarmellose sodium, a disintegrant, intragranularly, extragranularly, or equally between the two phases of a tablet containing a poorly soluble medication comprising at least 92.5% of the formulation were examined in a computer-optimized experiment. When the super disintegrant is added intragranularly, tablets with the same total concentration of crosscarmellose sodium dissolve more quickly, according to the results of an analysis using a general quadratic response surface model.

2. External Addition

The superdisintegrant is added to the granules during dry mixing before compression in both the wet and dry granulation methods. Wet granulation was used to study the impact of the mode of incorporation of superdisintegrants (croscarmellose sodium, sodium starch glycocolate, and crospovidone) on the dissolution of three model drugs with different aqueous solubilities (acetaminophen, cetrizine HCl, and carbamazepine) from their respective tablet formulations. It has been demonstrated that crospovidone is useful in enhancing medication dissolving in extra granular mode of addition; this style of inclusion appears to be the most efficient, regardless of the solubility of the primary tablet component.

3. Internal and External Addition

The disintegrant is split into two parts in this manner. Before granule formation, one component is added (intra), and the remaining portion is added (extra) to the granules after mixing and before compression. This approach might work better. When both intragranular and extragranular procedures are applied, the drug material is released into solution when the extragranular section of the tablet breaks into granules and the granules further dissolve by the intragranular portion. However, because the intra-granular disintegrant is subjected to wetting and drying during the granulation process, which lowers the disintegrant's activity, it is often less effective than the extra-granular portion in wet granulation methods. Since it is not exposed to wetting and drying during a compaction process, the intragranular disintegration activity is typically retained by the disintegrant.[43]

CONCLUSION

The optimal dispersion of an oral solid dose form should occur into the primary particles from which it was made. For tablets and capsules that require quick disintegration, using the appropriate disintegrant is essential to achieving maximum bioavailability. Solid dose forms are made more effective by the use of superdisintegrants. This is accomplished by reducing the disintegration time, which raises the pace at which drugs dissolve. Disintegrants are compounds, or mixtures of substances, added to the medicine formulation that help the content of tablets and capsules break up or disintegrate into tiny particles that dissolve more quickly than they would if disintegrants weren't present. Superdisintegrants are often utilized in solid dosage forms at modest levels, approximately 1–10% by weight in relation to the dosage unit's total weight. The several types of superdisintegrants that are employed in formulations to deliver drugs in a safer, more efficient manner while ensuring patient compliance are included in this study.

The aforementioned study came to the conclusion that both natural and synthetic superdisintegrants work better on tablets that dissolve quickly. Fast-dissolving tablets made with natural superdisintegrants in various combinations and direct compression techniques. Because they are naturally derived, offer nutritional supplements, are readily available at a reasonable cost, and are nontoxic, natural superdisintegrants are chosen over synthetic ones. The purpose of adding

disintegrants is to enhance the tablet fragments' surface area and to weaken the cohesive forces that hold the particles in the tablet together. When disintegrants become wet, they expand and dissolve, causing the tablet to disintegrate in the stomach and release the active components for absorption. Until recently, starch was the only excipient employed as a disintegrant. They make sure that the tablet quickly breaks down into tiny fragments when it comes into contact with water, thereby promoting dissolution. Several types of superdisintegrants have been used to successfully market rapidly dissolving dosage formulations.

REFERENCE

1. Lachman L, Lieberman HA, Kanig JL. The theory and practice of industrial pharmacy.Edn3, Bombay: Varghese publishing house. 1996.
2. Bi Y, Sunada H,Yonezawa Y, Danjo K, Otsuka A and Iida K. Preparation and evaluation of a compressed tablet rapidly disintegrating in the oral cavity.Chem Pharm Bull. 1996;44(11):2121-27.
3. Chang RK, Guo X, Burnside B and Couch R. Fast-dissolving tablets, Pharm Technol.2000; 4(6): 52-58.
4. Dobetti L. Fast-melting tablets: Developments and technologies. Pharm Technol Eur.2000;12(9):32-42.
5. Kaushik D, Dureja H and Saini TR. Mouth dissolving tablets: A review,Indian Drugs.2004;41(4):187-93.
6. Bandari S, Mittapalli RK, Gannu Rand Rao YM. Orodispersible tablets: an overview. Asian J Pharm. 2008; 2: 2- 11.
7. Panigrahi D, Bagels S and Mishra B. Mouth dissolving tablets: an overview of preparation techniques, evaluation and patented technologies.J Pharm Res.2005; 4(3):33-38
8. Kaur T, Gill B, Kumar S,Gupta GD. Mouth dissolving tablets: a novel approach to drug delivery. Int J Curr Pharm Res 2011; 1:1-7.
9. Patel TS, Sengupta M. Fast dissolving tablet technology. World J Pharm Sci 2013; 2:485-508.
10. Gupta DK, Bajpai M, Chatterjee DP. Fast mouth is dissolving disintegrating tablet and patient counselling points for FDDTS-a review. Int J Res Dev Pharm L Sci 2014; 3: 949-58.
11. Nautiyal U, Singh S, Singh R, Gopal, Kakar S. Fast dissolving tablets as a novel boon: a review. J Pharm Chem Biol Sci 2014; 2: 5-26.
12. 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.
13. Mishra US, Prajapati SK, Bhardwaj P. A review on formulation and evaluation for mouth dissolving tablet. World J Pharm Pharm Sci 2014; 8:1778-810.
14. Sharma S. New generation of the tablet: fast dissolving tablet. Latest Rev Pharmainfo Net; 2008. p. 6.
15. Kumari S, Visht S, Sharma PK, Yadav RK. Fast dissolving drug delivery system: a review article. J Pharm Res 2010; 3:1444-9.
16. Kumaresan C. Orally disintegrating tablet-mouth dissolving, sweet taste and target release profile. Pharm Rev 2008; 6:1.
17. Polyplasdone Superdisintegrants Product Overview.www.anshulindia.com/pdfs/poly plasdone.
18. Polyplasdone Crospovidone Nonionic superdisintegrant for improved dissolution of cationic drugs. www.isppharmaceuticals.com
19. Singh I, Rehni AK, Kalra R, et al. Ion Exchange Resins. FABAD J Pharm Sci. 2007; 32:91-100.
20. www.anshulindia.com/pdfs/polyplasdone
21. Pahwa R and Gupta N. Superdisintegrants in the Development of Orally Disintegrating Tablets. A Review. Int. J Pharma. Sci. and Res. 2011; 2:80-2767.

22. Kuchekar BS, Bhise SB, Arungam V. Design of Fast Dissolving Tablets. Indian J Pharm Edu. 2005; 35:150.
23. Shihora H and Panda S. Superdisintegrants, Utility in Dosage Forms: A Quick Review. JPSBR. 2011; 1:53-148.
24. Reddy LH, Ghosh B, Rajneesh S. Fast dissolving drug delivery system: A review of literature. Indian J Pharm Sci. 2002; 64:331-336.
25. Shirsand SB, Sarasija S, Para MS, et al. Plantago ovata mucilage in the design of fast disintegrating tablets. Indian J Pharmaceutical Sciences. 2009; 210. https://doi.org/10.4103/0250-474X.51952
26. Ghenge G, Pande SD, Ahmad A, et al. Development and characterisation of fast disintegrating tablet of Amlodipine besylate using mucilage of Plantago ovata as a natural superdisintegrant. Int. J Pharm Tech Research. 2011; 3:938-945
27. Shihora H, Panda S, Superdisintegrants,Utility in Dosage form: A Quick Review, J Pharma Sci. & Bioscientific Res. 2011; 1(3):148-153.
28. Ismail M, Kareemulla S, Raheem M A, Ahmed M, Basha S G, Anjum Z, Rahman S, Formulation and Evaluation of Mouth Dissolving Tablets of Amiodarone HCL by using Natural Superdisintegrants, International Journal of Current Research, 2017; 9(2):46761-46778.
29. Sharma S, Sonawane R. Role of superdisintegrants in immediate release tablets. A review. J Pharm BioSci 2017; 5:1-5. https://doi.org/10.31555/jpbs/2017/5/1/1-5
30. Dhiraj A, Khairnar, Sanjay P, Anantwar, Chetan S, Chaudhari, Pravin, Shelke, Superdisintegrants, An Emerging Paradigm in Orodispersible Tablets, International Journal of Biopharmaceutics, 5(2), 2014, 119-128.
31. Kumar N P, Nayyar P, Kumar S P. Superdisintegrants- current approach, Journal of Drug Delivery and Therapeutics. 2014; 4(3):37-44. https://doi.org/10.22270/jddt.v4i3.831
32. Yael Is Beth Cornejo-Ramírez et al., The structural characteristics of starches and their functional properties, Taylor, and Francis, 2018; 16:10031017. https://doi.org/10.1080/19476337.2018.1518343
33. Jane J, Starch Properties, Modifications, and Applications, Journal of Macromolecular Science, 24 Sep 2006; 751-757. https://doi.org/10.1080/10601329508010286
34. Desai P M, Liew C V, Sia Heng P W, Review of Disintegrants and the Disintegration Phenomena, Journal of Pharmaceutical Sciences 2016; 105:2545-2555. https://doi.org/10.1016/j.xphs.2015.12.019
35. Adjei F K, Osei Y A, Kuntworbe N, and Ofori-Kwakye K, Evaluation of the Disintegrant Properties of Native Starches of Five New Cassava Varieties in Paracetamol Tablet Formulations. Journal of Pharmaceutics, 2017:1-9 https://doi.org/10.1155/2017/2326912
36. Consuelo Souto Alberto Rodríguez Silvia Parajes Ramón Martínez-Pacheco, A comparative study of the utility of two superdisintegrants in microcrystalline cellulose pellets prepared by extrusion- spheronization, European Journal of Pharmaceutics and Biopharmaceutic(Elsevier), September 2005; 61(1-2):94-99. https://doi.org/10.1016/j.ejpb.2005.04.003
37. Available at http://www.pharmatutor.org/articles/novelfast-dissolving-tablets- scomprehensive-review.
38. Nayyar Nawaz, Anam Nasir, Ayesha hameed, Zoya shah, Javeria saleem, Sana naeem, Superdisintegrants, Proceedings of Second International Multi-Disciplinary Conference 19-20 December 2016, Gujrat, Pakistan.
39. Debjit Bhowmik, Rishab Bhanot, Sampath Kumar, Recent trends in role of Superdisintegrants to formulation of solid oral dosage form, Research Journal of Pharmaceutical Dosage Forms and Technology, 10(4), 2018, 245-252
40. Available at http://www.pharmainfo.net/tabletdisintegrants
41. Hardik Shihora, Subhranshu Panda, Superdisintegrants Utility in Dosage Forms, A Quick Review, Journal of Pharmaceutical Scientific Bioscience and Review, 1(3), 2011, 148-153.

42. Rakesh Pahwa and Nisha Gupta, Superdisintegrants in the Development of Orally Disintegrating Tablets, International Journal of Pharmaceutical Science and Research, 2(11), 2011, 2767-2780.
43. www.pharmatutor.org/article/overview - superdisintegrants