

AN OVERVIEW ON SUPERDISINTEGRANTS: A REVIEW

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ABSTRACT

Oral route is the most preferred route for administration of various drugs because it is regarded as safest, most convenient and economical route. The demand for fast disintegrating tablets, capsule has been growing during the last decade especially for geriatric and pediatric patients because of swallowing difficulties. Nowadays several newer agents have been highly-developed identified as Superdisintegrants. Superdisintegrants are the ingredients, which facilitate the quicker disintegration with lesser quantity in compare to disintegrants. Their demand is progressively increasing. Some tablets are designed to dissolve in saliva remarkably fast, within a few seconds, and are true fast- dissolving tablets. Here in this review article we are going to overview about of various disintegrates like natural, synthetic, co-proceed. The present review comprises the various kinds of Superdisintegrants like natural and synthetic which are being used in the formulation to provide the safer, effective drug delivery with patient's compliance.

KEYWORD: Disintegrants, Disintegration, Superdisintegrating agent.**INTRODUCTION**

Oral route for the drug delivery is the most attractive route for the delivery of drugs. Different kinds of dosage forms administered orally, the tablet is the most desired dosage forms among them. For of its ease of preparation, ease in administration, correct dosing, and stability related with oral liquids and because it is more tamper proof than capsules. A fast dissolving tablet (FDT) system can be defined as a dosage form for oral administration, which when placed in mouth, rapidly dispersed or dissolved and can be swallowed in the form of liquid. The small volume of saliva is usually sufficient to result in tablet disintegration in the oral cavity. The medication can then be absorbed partially or entirely in to the systemic circulation from blood vessels in the sublingual mucosa, or it can be swallowed as a solution to be absorbed from gastrointestinal tract. Tablet disintegration has received considerable attention as an essential step in obtaining faster drug release. The proper choice of a disintegrant or a superdisintegrant and its consist performance are of critical importance to the formulation development of such tablets. Drug release from a solid dosage form can be enhanced by addition of suitable disintegrants. In more recent years, increasing attention has been paid to formulating not only fast dissolving and/or disintegrating tablets that are swallowed, but also orally disintegrating tablets that are intended to dissolve and/or disintegrate rapidly in the mouth. An ideal disintegrant should have poor solubility, poor gel formation, good hydration capacity, good

compressibility, flow properties and no tendency to form complexes with the drugs.

Selection of SuperDisintegrants

There are many factors which are considered in selection of Superdisintegrants.

- Quantity of disintegrates present in preparation.
- Tablet hardness.
- Kind of addition and mixing.
- Drug nature.
- Good flow ability.
- Occurrence of surface active agents.
- Compactable to formulate less friable tablets.
- Good mouth feel produce to the patient.

Table 1: List of Superdisintegrants

SUPERDISINTEGRANTS	BRAND NAMES	MECHANISM OF ACTION	CONCENTRATION IN GRANULES (% W/W)
Crosslinked pvp	Cross-povidone M®, Kollidon, Polyplasdone, Polyplasdone XL®, Kollidone CL®	Swells 7-12 folds in <30 seconds Swells very little and returns to original size after compression but act by capillary action	2 - 5 %
Crosscarmellose® Ac-Di-Sol® Nymce ZSX® Solutab® L-HPC Primellose® Vivasol®	Crosscarmellose® Ac-Di-Sol® Nymce ZSX® Solutab® L-HPC Primellose® Vivasol®	Swells 4-8 folds in <10 seconds. Swelling and wicking both.	2 – 5%
Avicel ^(r) (PH 101, PH 102)	Avicel ^(r) (PH 101, PH 102)		10 – 20%
Methyl Cellulose	Methyl Cellulose		2 – 10%
Colloidal Silicon Dioxide	Colloidal Silicon Dioxide		1 - 5 %
Cross linked Alginic acid	Alginic acid NF®, Staialgine®	Rapid swelling in aqueous medium or wicking action	1 – 5%
Crosslinked Starch	Explotab®, Primogel®, Tablo®, Vivastar Starch 1500	5 – 50%	5 – 10% 1 – 6%
Sodium starch glycol ate	Sodium starch glycol ate	Swells 7-12 folds in <30 seconds	10%
Locust bean gum	Locust bean gum		5%
Isaphghulla Husk	Isaphghulla Husk		10%
Hibiscus Rosa sinesis Linn.	Hibiscus Rosa sinesis Linn.		
Fenugreek seed mucilage	Fenugreek seed mucilage		
Soy polysaccharides	Soy polysaccharides Emcosoy®	Rapid Dissolving	
Xanthum Gum	Grindsted®, Xanthum SM®		
Gallen Gum	Kilcogel®		
Ion Exchange Resin	Indion 414®, Tusion 339®, Amberlite IRP 88®		
Calcium Silicate	Calcium Silicate	Wicking action	
Polyplasdone(XL)	Crosslinked PVP		0.5 – 5%
Amberlite(IPR 88)	Ion exchange resin		0.5 – 5%

1. Swelling

Swelling is believed to be a mechanism in which certain disintegrating agents (such as starch) impart the disintegrating effect. By swelling in contact with water, the adhesiveness of other ingredients in a tablet is over come causing the tablet to fall apart. E.g. Sodium starch glycolate, Platago Ovata. Fig 1.

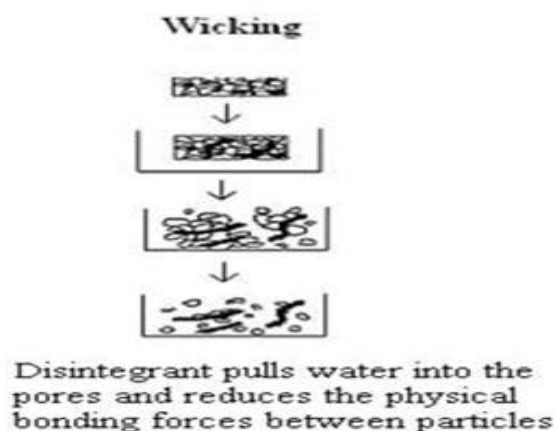
Swelling

Particles swell and break up the matrix from within; swelling sets up; localized stress spreads through out the matrix

2. Porosity and Capillary Action (Wicking)

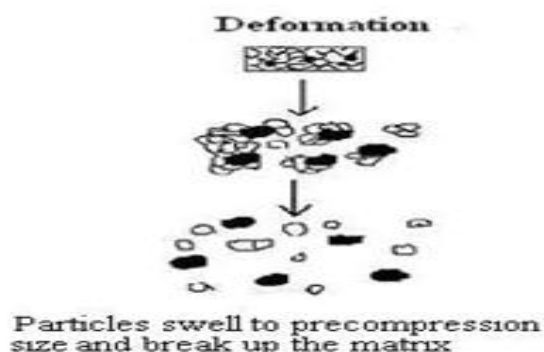
Effective disintegrants that do not swell are believed to impart their disintegrating action through porosity and capillary action. Tablet porosity provides pathways for the penetration of fluid into tablets. The disintegrant particles (with low cohesiveness and compressibility) themselves act to enhance porosity and provide these pathways into the tablet. Liquid is drawn up or “wicked” into these pathways through capillary action and rupture the inter particulate bonds causing the tablet to break apart as shown in Fig 1. Crospovidones are synthetic, insoluble, crosslinked homopolymers of N-vinyl-2-pyrrolidone. Crospovidone quickly wicks saliva into the tablet to generate the volume expansion and hydrostatic pressures necessary to provide rapid disintegration. Unlike other superdisintegrants which rely principally on swelling for disintegration, crospovidones uses a combination of swelling, wicking and deformation^[13,14] formulated fast dissolving Efavirenz formulation by using three different superdisintegrants such as

crosscarmellose sodium (CCS), sodium starch glycolate (SSG) and crospovidone (CP). It is concluded that CP is able to release the drug faster than the other two disintegrants. Fig 2.



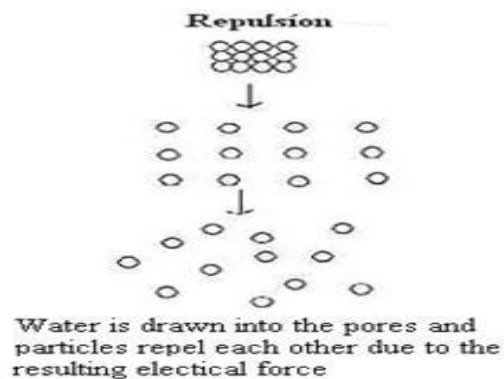
3. Deformation

Hess had proved that during tablet compression, disintegrated particles get deformed and these deformed particles get into their normal structure when they come in contact with aqueous media or water. Occasionally, the swelling capacity of starch was improved when granules were extensively deformed during compression. Fig 3.



4. Due to disintegrating particle/particle repulsive forces

Another mechanism of disintegration attempts to explain the swelling of tablet made with "nonswellable" disintegrants. Guyot-Hermann has proposed a particle repulsion theory based on the observation that nonswelling particle also cause disintegration of tablets. The electric repulsive forces between particles are the mechanism of disintegration and water is required for it. Researchers found that repulsion is secondary to wicking. It is believed that no single mechanism is responsible for the action of most disintegrants. But rather, it is more likely the result of inter-relationships between these major mechanisms. Fig 4.



5. Heat of wetting

When disintegrants with another microproperties 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.

6. Due to release of gases

Carbon dioxide released within tablets on wetting due to interaction between bicarbonate and carbonate with citric acid or tartaric acid. The tablet disintegrates due to generation of pressure within the tablet. This effervescent mixture is used when pharmacist needs to formulate very rapidly dissolving tablets or fast disintegrating tablet. As these disintegrants are highly sensitive to small changes in humidity level and temperature, strict control of environment is required during manufacturing of the tablets. The effervescent blend is either added immediately prior to compression or can be added in to two separate fraction of formulation.^[18]

7. Combination action

In this mechanism, the combination of both wicking and swelling action facilitate disintegration. E.g. Crospovidone

8. 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. Some examples of disintegrating enzymes are presented in table 1 along with the binders against which these are active.

Table 2: Disintegrating Enzymes

ENZYMES	BINDER
Amylase	Starch
Protease	Gelatin
Cellulase	Cellulose and its derivatives
Invertase	Sucrose

Types of Superdisintegrants

1. Natural Superdisintegrants.
2. Synthetic Superdisintegrant.
3. Co – processed.

1. Natural Superdisintegrants

These are various plant based material. Plant based material serve as an alternative to synthetic products because of following reasons:-

- Local accessibility.
- Eco –friendly.
- Bio-acceptable.
- Renewable source and low price as compared to synthetic products.

A. Isapgghula Husk Mucilage (*Plantago ovata*)

Isapgghula Husk consists of dried seeds of the plant known as *plantago ovata*. The plant contains mucilage in the epidermis of the seeds. Mucilage of *plantago ovata* has different characteristics like binding, disintegrating and sustaining properties. Mucilage can be used as superdisintegrant to formulate fast dissolving tablets because it has very high percentage of swelling index (around $89 \pm 2.2\%$ v/v) as compared to the other superdisintegrating agents. The rapid disintegration of the FDTs are due to the swelling of Superdisintegrants to create enough hydrodynamic pressure for quick and complete disintegration of the tablet. The rate at which swelling develops and significant force of swelling also determine its disintegrating efficiency.

B. *Lepidium sativum* Seed Mucilage

It is also known as a *salayo*. Natural *Lepidium sativum* (family: Cruciferae), has wide application in pharmaceutical field as disintegrating agent and as herbal medicine. Seeds contain a major proportion of mucilage, dimeric imidazole alkaloids *lepidine B, C, D, E* and *F* and two new monomeric imidazole alkaloids *semilepidinoside A* and *B*. The mucilage can be extracted from seeds by different procedures and its yield varies from 14% to 22%. Mucilage of *Lepidium sativum* has various characteristic like binding, disintegrating, gelling etc. The extracted mucilage is used to develop fast dissolving tablets. Mucilage is found to be a brownish white powder which decomposes above 200°C and have characteristic odour evaluating its various physicochemical characteristics, the values of swelling index, angle of repose, bulk density and tapped density are estimated as following 18, 32°C, 0.58g/cc and 0.69g/cc respectively.

C. Fenugreek Seed Mucilage

Trigonella Foenum-graceum (leguminous family). It is an herbaceous plant. It has found wide applications as a food, a food additive, and as a traditional medicine. The leaves and both the ripe and unripe seeds of *Trigonella Foenum-Graceum* are used as vegetables. Fenugreek has been used in treating dyspepsia with loss of appetite, chronic cough, dropsy, enlargement of liver and spleen, rickets, colic flatulence, dysentery, diarrhoea, gout, and

diabetes. It is also used as gastro protective, antiurolithiatic, diuretic, antidandruff agent, Anti-inflammatory agent and as antioxidant. The seed is stated to be a tonic. It also is used in post-natal care and to increase lactation in nursing mothers. Fenugreek seeds contain a high percentage of mucilage (a natural gummy substance present in the coatings of many seeds). Although it does not dissolve in water, mucilage forms a viscous tacky mass when exposed to fluids. Like other mucilage-containing substances, fenugreek seeds swell up and become slick when they are exposed to fluids. The resulting soft mass is not absorbed by the body, but instead passes through the intestines and triggers intestinal muscle contractions.

D. Gellan Gum (Kicogel)

Gellan gum is obtained from *Pseudomonas elodea*. It is a linear anionic polysaccharide biodegradable polymer consisting of a linear tetrasaccharide repeat structure as shown in Fig and is used as a food additive. Gellan gum as a superdisintegrant and the efficiency of gum is compared with other conventional disintegrants such as dried corn starch, *explotab*, *avicol* (pH 102), *Ac di-sol* and *Kollidon CL* studied by Antony *et al.* The disintegration of tablet might be due to the instantaneous swelling characteristics of gellan gum when it comes into contact with water and owing to its high hydrophilic nature. The complete disintegration of tablet is observed within 4 minutes with gellan gum concentration of 4 percent w/w and 90 percent of drug dissolved within 23 minutes. *Ac-di-sol* and *Kollidone CL* shows very similar pattern of disintegration and *in vitro* dissolution rates. With the same concentration tablet with *explotab* show 36 minutes for 90% of drug release and with starch show 220 minutes. From this result gellan gum has been proved itself as a superdisintegrant.

E. Locust Bean gum

Locust bean gum also called Carob bean gum. It is extracted from the endosperm of the seeds of the carob tree *Ceretoniasiliqua*, which grows in Mediterranean countries. Some other familiar polysaccharides are starch and cellulose, which are made of long chains of the sugar glucose. In locust bean gum, the ratio of mannose to galactose is higher than in guar gum, giving it slightly different properties, and allowing the two gums to interact synergistically so that together they make a thicker gel than either one alone. It shows as a binder and as a disintegrant property at different concentration. Locust bean gum has been widely used in food industry as a thickening and gelling agent. Locust bean gum has also been reported to have bio adhesive and solubility enhancement properties.

F. Chitin and Chitosan

Chitin (β -(1→4)-N-acetyl-D-glucosamine) is a natural polysaccharide obtained from crab and shrimp shells. It possesses amino group covalently linked to acetyl group as compared to liberate amino group in chitosan. Chitosan is produced commercially by deacetylation of

chitin, which is the structural element in the exoskeleton of crustaceans (such as crabs and shrimp) and cell walls of fungi. Bruscatto and Danti, 1978, reported that when chitin was included in the conventional tablets, the tablets disintegrated within 5 to 10 minutes irrespective of solubility of the drug. The disintegration time in the oral cavity as well as wetting time could be analyzed by surface free energy. Chitosan is the best known natural polysaccharide utilized for its multifarious applications in pharmaceutical industry.

G. Gum Karaya

Gum karaya is a vegetable gum produced as an exudate by trees of the genus *Sterculia*. Chemically, gum karaya is an acid polysaccharide composed of the sugars galactose, rhamnose, and galacturonic acid. The high viscosity nature of gum limits its uses as binder and disintegrant in the development of conventional dosage form. Gum karaya has been investigated for its potential as a tablet disintegrant. Different results showed that modified gum karaya produces rapid disintegration of tablets. Gum karaya can be utilized as an alternative superdisintegrant to commonly available synthetic and semisynthetic superdisintegrants due to its low cost, biocompatibility as well as facile availability.

H. Agar and Treated Agar

It is the dried gelatinous substance obtained from *Gelidium amansii* (Gelidaceae) and several other species of red algae like *Gracilaria* (Gracilariaceae) and *Pterocladia* (Gelidaceae). Agar is yellowish-gray or white to proximately colorless, inodorate with mucilaginous taste and is available in the form of divests, sheet flakes, or coarse powder. Agar consists of two polysaccharides, agarose and agar pectin. Agarose is responsible for gel vigour and agar pectin is responsible for the viscosity of agar solutions. High gel vigour of agar makes it a potential candidate as a disintegrants.

I. Soy Polysaccharide (Emcosoy®)

It is a natural superdisintegrants that does not contain any starch or sugar so can be utilized in nutritional products. Halakatti et al. 2010 evaluated soy polysaccharide (a group of high molecular weight polysaccharides obtained from soy beans) as a disintegrant in tablets made by direct compression utilizing lactose and dicalcium phosphate dihydrate as fillers. A cross-linked sodium carboxymethyl cellulose and corn starch was utilized as control disintegrants. Soy polysaccharide performs well as a disintegrating agent in direct compression formulations with results paralleling those of cross-linked CMC.

J. Mango Peel Pectin

Mango peel which constitutes 20–25% of the mango processing waste was found to be a good source for the extraction of pectin of good quality, felicitous for the preparation of film, and acceptable jelly. Pectin is an in volute heteropolysaccharide which is a hydrophilic colloid. Malviya et al. (2011) investigated and found that

mango peel pectin stands as a good candidate as superdisintegrant, though not as more strong than synthetic superdisintegrants, but due to its good solubility and higher swelling index, it may be utilized in the formulation of fast dispersible tablets.

K. Plantago ovata Seed Mucilage

Psyllium or ispaghula is the prevalent name utilized for several members of the plant genus *Plantago* whose seeds are utilized commercially for the production of mucilage. Mucilage of *Plantago ovata* has different characteristics like binding, disintegrating, and sustaining properties. In an investigation fast disintegrating tablets of amlodipine besylate was yare by direct compression method utilizing different concentrations of *Plantago ovata* mucilage as natural superdisintegrants. All formulations were evaluated for weight variation, hardness, friability, disintegration time, drug content, and dissolution. The optimized formulation shows less *in vitro* disintegration time of 11.69 seconds with rapid *in vitro* dissolution within 16 minutes. *In vitro* disintegration time decreases with increase in concentration of natural superdisintegrant.

L. Aegle marmelos Gum (AMG)

It is obtained from the fruits of *Aegle marmelos* belonging to the disintegrated faster and consistently than the croscarmellose sodium. The ripened fruit pulp is red in colour with mucilaginous and astringent taste. The pulp contains carbohydrates, proteins, vitamin C, vitamin A, angelenine, marmeline, dictamine, O-methyl fordinol and isopentyl halfordinol. AMG is prepared by heat treatment technique. It increases the solubility of poorly soluble drugs. It increases glucose level and glycosylated haemoglobin in diabetic patients, decreases plasma insulin and liver glycogen in diabetic patient, decreases lipid per oxidation, stimulates macrophage functioning, and causes significant deviation in the GSH (glutathione) concentration in liver, kidney, stomach, and intestine. Purified, bael gum polysaccharide contains D-galactose (71%), D-galacturonic acid (7%), L-Rhamnose (6.5%), and L-arabinose (12.5%).

M. Ficus Indica Fruit Mucilage

The mucilage of ficus indica fruit is utilized as superdisintegrant which is obtained from the pulp of fruit ficus indica. Ficus indica is an astronomically immense tree up to 3 meters and very fast-growing with spread branches and arial roots. The fruits of ficus indica are of the size of cherry. It has nutritional as well as medicinal value. The dried and uncooked ficus indica fruit gives 230 kcal (963 KJ) of energy per 100 gm or 3.5 oz. (ounce). It is utilized in assuaging fever, pain, inflammation, wound rejuvenating, blood quandaries, and urinary quandaries.

N. Mangifera indica Gum (MIG)

Mundane name of *Mangifera indica* is mango, and it belongs to Anacardiaceae family. It is nontoxic and utilized as disintegrant, binder, suspending agent, and

emulsifying agent in different formulations. The gum powder is white to off white in colour, and the powder was soluble in water and virtually insoluble in acetone chloroform, ether, methanol, and ethanol. It is facily available, and gum is devoid of toxicity, and each and every component of the tree has pharmacological activity like diuretic, astringent, diabetes, asthma, diarrhea, urethritis, and scabies.

O. Hibiscus Rosa Sinensis Mucilage and Treated Agar

It is withal called shoe flower plant, China rose, and Chinese hibiscus and belongs to the family Malvaceae. Mucilages are utilized as thickeners, suspending agent, water retention agent, and disintegrants. The plant is facily available and its leaves contain mucilage and is present in mucilage L-rhamnose, D-galactose, D-galacturonic acid, and D-glucuronic acid. Treated agar is yare by treating it with water for one day.

P. Dehydrated Banana Powder (DBP)

Banana is additionally called plantain. DBP is yare from the variety of banana called Ethan and nenthra (*nenthra vazha*) and belongs to the family Musaceae. It contains vitamin A, so it is utilized in the treatment of gastric ulcer and diarrhea. It withal contains vitamin B6, which avails in reducing the stress and solicitousness. It is a very good source of energy due to high carbohydrate content, and it contains potassium, which is responsible for more preponderant brain functioning.

Q. Cassia fistula gum

Seeds of Cassia fistula gum obtained from cassia fistula tree. Gum obtained from the seeds of Cassia fistula comprises β -(1 \rightarrow 4) linked d-mannopyranose units with random distribution of α (1 \rightarrow 6) linked d-galactopyranose units as side chain having mannose: galactose ratio of 3.0). Carboxymethylation as well as carbamoylethylation of Cassia gum is reported to improve cold watersolubility, improve viscosity and increase microbial resistance as compared to native gum. Therefore, an attempt was made to incorporate calcium or sodium salts of carboxymethylated or carbamoylethylated C. fistula gum as superdisintegrant in the formulation development of FDT.

R. Cucurbita Maximum

Pulp Powder Malviya *et al.*, carried of the evaluation of cucurbita with diclofenac sodium and prepared various concentrations of 2.5, 5, 7.5, 10% and these also sent for various tested like friability drug content, drug disintegration time, and this study also proves that this is a good pharmaceutical adjuvant and disintegrating agent.

S. Ocimum Americanum Seed Mucilage

Patel *et al* prepared the propanolal hydrochloride tablets using ocimum americanum seed mucilage using various concentrations like 2, 4, 6, 8, 10% the optimum concentration of mucilate for rapid dissolution is shown at 10% and the same concentration with starch and

propanaolal hydrochloride is prepared and shows disintegration time of 269 seconds while ocimum shows the disintegration in 154 seconds. The hardness friability drug content is within limit.

2. Synthetic Superdisintegrants.

A. Sodium starch glycolate (primo gel, explotab, tablo, vivastar)

It is also called as sodium carboxy methyl starch. It is a modified starch. It is a cross linked polymer of carboxymethyl starch. Generally potato starch is used to synthesize sodium starch Glycol ate it gives the product with the best disintegrating properties. After selection of the appropriate starch source the next step is the crosslinking of the potato starch by using an FDA approved starch esterifying agent such as sodium trimetaphosphate or phosphorus oxychloride in alkaline suspension. Introduction of the large hydrophilic carboxymethyl groups is to disrupt the hydrogen bonding within the polymer structure. It allows water to penetrate the molecule and the polymer becomes cold water soluble. Cross-linking reduce both the water soluble fraction of the polymer and the viscosity of dispersion in water. The optimum balance between the degree of substitution and the extent of cross-linking allows for rapid water uptake by the polymer without the formation of a viscous gel hat might impede dissolution.

B. Crosspovidone (polyplasdone XL, polyplasdone XL 10, kollidon CL)

These are synthetic, insoluble, cross linked homopolymers of N-vinyl -2-pyrrolidone. Under scanning electron microscope; Crosspovidone particles appear as granular and are highly porous. It does not form complexes with drugs because of their nonionic nature. Crosspovidone act by combination of mechanisms to provide rapid disintegration. Although Crosspovidone polymers swell by 95% to 120% upon contact with water, swelling is not the only mechanism for tablet disintegration. Their porous particle morphology rapidly absorbs water (wicking) via capillary action. In addition, during tablet compaction, the highly compressible. Crosspovidone particles become extremely deformed. When the deformed Crosspovidone particles come in contact with water that is wicked into the tablet, the Crosspovidone particles recover their normal structure and then swell, resulting in rapid volume expansion and high hydrostatic pressures that cause tablet disintegration. Due to its high crosslink density, Crosspovidone swells rapidly in water without gelling. Crosspovidone are highly compressible materials as a result of their unique particle morphology. At low concentration levels (2-5%) crosspovidone is used as superdisintegrant in direct compression, wet and dry granulation processes.

C. Croscarmellose sodium (AC-Di-Sol, nymce ZSX, primellose, vivasol, solutab)

Croscarmellose sodium is modified cellulose and is described as a cross-linked polymer of

carboxymethylcellulose. Apart from the differences between the starch and cellulose polymer backbones, there are differences between the synthetic processes used to modify the polymer. Most importantly, the disintegration rate of Croscarmellose sodium is higher than that of sodium starch glycolate and the mechanism of cross linking is different. The substitution is performed using Williamson's ether synthesis to give the sodium salt of carboxymethylcellulose. A key difference from the chemistry of SSG is that some of the carboxymethyl groups themselves are used to cross-link the cellulose chains, the process being accomplished by dehydration. Thus the cross-links are carboxyl ester links rather than phosphate ester links as in Primojel. Croscarmellose sodium is a cross linked polymer of carboxymethyl cellulosesodium. Cross linking makes it insoluble, hydrophilic, highly absorbent material, resulting in excellent swelling properties and its unique fibrous nature gives it excellent water wicking capabilities. It also provides superior drug dissolution and disintegration characteristics, thus improving bioavailability. It is used in oral pharmaceutical formulations as a superdisintegrant for tablets, capsules and granules.

D. Resin

Resins although insoluble, have great affinity for water and hence, act as disintegrant. Moreover, because of their smaller particle size the rate of swelling is high making them superdisintegrant. Like conventional disintegrant, they don't lump but additionally impart strength to the tablets. The use of ion exchange resins into drug delivery systems have been encouraged because of their physicochemical stability, inert nature, uniform size, spherical shape assisting coating and equilibrium driven reproducible drug release in ionic environment. Ion exchange resins are insoluble polymers that contain acidic or basic functional groups and have the ability to exchange counter-ions within aqueous solutions surrounding them. Drug, molecules attached to the resins is released by appropriate charged ions in the gastrointestinal tract, followed by diffusion of free drug molecules out of the resins.

E. Low Substitued Hydroxy Methyl Cellulose

It has high degree of swelling due to its large particle size and used to prevent capping. It is widely used now a day in wet granulation method and directly compressible method. Here the combination of micro crystalline cellulose and low hydroxyl propyl cellulose are used for rapidly disintegrating the tablet. As the ratio of these both of 8:2 and 9:1 to get rapid disintegration.

F. Micro Crystalline Cellulose [MCC (Avicel 102)]

This tablet disintegrates by allowing the water into its porous structure as it enters the hydrogen bonding between the cellulose particles are ruptured and it achieves good disintegration. This is partially depolymerized synthesized from alpha cellulose. This is mainly used for direct compression method. When

compressed the MCC particles are deformed plasticity due to their slip planes and dislocation. Here avicel 102 is used as diluents as well as disintegrant with its mechanism of interlocking as it is small size has advantages like rapid disintegration and increased binding strength.

G. Calcium Silicate

It is light in weight disintegrate with mechanism of action of wicking. When used in the concentration of 5%

H. Cross-linked alginic acid (Alginic acid NF)

It is insoluble in water and disintegrates by swelling or wicking action. It is a hydrophilic colloidal substance, which has high sorption capacity. It is also available as salts of sodium and potassium.

I. Ion exchange resins (indion 414, Tulsion 339, Amberlite IRP 88)

The INDION 414 has been used as a superdisintegrant for ODT. It is chemically cross-linked polyacrylic, with a functional group of $-\text{COO}^-$ and the standard ionic form is K^+ It has a high water uptake capacity. It is a high purity pharmaceutical grade weak acid cation exchange resin supplied as a dry powder. It is an extremely effective tablet disintegrant which provides the necessary hardness and chemical stability to the tablet. The product swells up to a very great extent when in contact with water or gastrointestinal fluids causing rapid disintegration without the formation of lumps. It is a high molecular weight polymer, therefore it is not absorbed by the human tissues and totally safe for human consumption.

J. Starch Partially Pre-Gelatinised

This is synthesized directly from starch grains in directly compressed method with intact and partially hydrolyzed property and a pharmaceutical aid like binder, filter and disintegrant here the concentration mainly used in nearly about 5-10% and swelling is main mechanism of action here. The ppg starches improved the tablet physical properties with few steps leading to a complex formation and dramatically lower costs. It has its chemical formula with rapid drug release.

3. Co-processed superdisintegrants

Co-processing is based on the novel concept of two or more excipients interacting at the subparticle level, the objective of which is to provide a synergy of functionality improvement as well as masking the undesirable properties of individual. Co-processing excipients lead to the formulation of excipient granules with superior properties, compared physical mixtures of components or individual components, like improved flow properties, improved compressibility, better dilution potential, fill weight uniformity, and reduced lubricant sensitivity. Several co-processed superdisintegrants are commercially available:

- Ludipress (lactose monohydrate, polyvinylpyrrolidone and crospovidone).

- Starlac (lactose and maize starch).
- Starcap 1500 (corn starch and pregelatinized starch).
- Ran Explo-C (microcrystalline cellulose, silica and crospovidone).
- Ran Explo-S (microcrystalline cellulose, silica and sodium starch glycolate).
- PanExcea MH300G (microcrystalline cellulose, hydroxyl-propyl-methyl cellulose and Crospovidone).
- Ludiflash (mannitol, crospovidone, and polyvinyl acetate).

4. Co – processed blend of Excipients

It involves the mixture blend of more than two excipients to satisfy the required quality using different technique like spray drying and freeze drying etc.

➤ Ludiflash

Ludiflash is an innovative, unique co-processed blend of Mannitol (95%), crospovidone (5%) and polyvinyl acetate (5%) manufactured in a validated patented process. It disintegrates rapidly within seconds with soft, creamy consistency. It is specially designed for direct compression on standard high speed tablet machine for hard tablet with very low friability. It gives extremely fast release rate.

➤ F-melt

F-MELT® is a spray-dried excipient used in orally disintegrating tablets that contain saccharides, disintegrating agent, and inorganic excipient. F-MELT exhibits excellent tableting properties and facilitates rapid water-penetration for a fast disintegration time.

➤ Pharmaburst

Pharmaburst is a Quick Dissolving delivery system in which there is addition of active drug in a dry blend with Pharmaburst excipients and compress by tablet machine. Pharmaburst is a co-processed excipient system with specific excipients, which allows rapid disintegration and low adhesion to punches.

➤ Mannogem EZ

Mannogem EZ is spraying dried Mannitol, specially designed for direct compression tablet. It has advantages of highly compatible, non hygroscopic, chemically inert, narrow particle size distribution and mainly rapid disintegration property benefits quick dissolve application. It is highly stable and inert to many of the chemical reactions which are problematic with lactose, microcrystalline cellulose, or starch.

➤ Modified Chitosan with silicon dioxide

This is the new excipients based on co-precipitation of Chitosan and silica. The physical interaction between Chitosan and silica create an insoluble, hydrophilic highly absorbent material, resulting in superiority in water uptake, water saturation for gelling formation. Studies have shown that Chitosan–silica delivers superior performance in wet granulation formulations

and is the only disintegrant that is effective at all concentrations in tablet formulation.

➤ Modified Resins

Polacrillin Potassium (Tulsion 339)

It is a crosslinked polymer of methacrylic acid and divinylbenzene supplied as the potassium salt. Polacrillin potassium is weakly acidic cation exchange resin. On wetting, the resin swells by approximately 150 %, thereby causing the tablet to disintegrate. Tablet disintegration property is due to its extremely large swelling capacity in aqueous solutions. Water can exert force between particles within tablet pores, but this force is low. This is used effectively at 1-2% of solid dosage forms. It is bio compatible and non-toxic. It is available in various grades i.e., tulsion-335, tulsio-344, tulsion-345 and tulsion-412.

➤ Modified Mannitol

Pearlitol 200 SD

These are the granulated Mannitol white, odourless, slightly sweet tasting, crystalline powder. It has a unique blend of exceptional physical and chemical stability, with great organoleptic, non-carcinogenic, sugar-free properties. Together with its versatile powder properties, it can be used in different processes wet or dry granulation, direct compression and compaction or freeze-drying. It has properties like flowability, excellent compressibility, non-hygroscopic and excellent chemical stability. Pearlitol SD dissolves very rapidly because of its porous crystalline particles.

Modified sugars

Glucidex IT

Glucidex IT is obtained by moderate hydrolysis of starch. It is micro granulated form enables almost instantaneous dispersal and dissolution in water. Different range of Glucidex IT products is available. All co-processed and modified excipients are playing a vital role in the development of easy dosage forms which are resistant to atmosphere. The improved physical, chemical and mechanical properties of such excipients as compared to existing excipients, have helped in solving formulation problems such as flowability, compressibility, hygroscopicity, palatability, dissolution, disintegration, sticking, and dust generation.

Table 3: A list of synthetic Superdisintegrant used in formulation.

Name of drug	Superdisintegrant	Method of Compression	Reference
Solubutamol Sulphate	Chitosan-alginate Complex	Direct compression	Kharade S. Bhutkar MA, 2013
Calcium Carbonate	Croscarmellose, Crospovidone, Sodium starch glycol ate	Wet granulation	Farhana M et al., 2013
Levofloxacin	Croscarmellose, Crospovidone(XL10), Sodium starch glycol ate	Wet granulation	Saeed Uran et al., 2013
Chlorphenearamine	Sodium starch glycol ate	Direct compression	Murtada AO et al., 2013
Domperidone	Croscarmellose, Crospovidone, Sodium starch glycolate	Direct compression	R.M Sarfraz 2015
Atenlol & Atorvastin	Croscarmellose, Crospovidone, Sodium starch glycol ate	Direct compression	Dasharath Patel 2014
Amlodipine Besylate	Plantago ovata mucilage	Direct compression	P.R rai 2012
Metoclopramide HCl	Cassia fistula gum	Direct compression	G. Ghenge 2011

Table 4: A list of natural superdisintegrant used in Formulations.

Name of drug	Superdiintegrant	Method of Compression	Reference
Diclofenac sodium	Fenugreek gum		M. Uday Kumar 2014
Sildenafil Citrate	Soy polysacchride		Mangesh R. Bhalekar
Ondansetron HCL	Plantago ovate husk	Direct compression	Mangal et al 2012
Granisetron HCL	Plantago ovate husk	Direct compression	
Fexofenadine HCL	Plantago ovate mucilage, seed powder	Direct compression	
Ofloxacin	Locust bean powder	Solvent evaporation method	

CONCLUSION

With the progress in the formulation of Rapid disintegrating tablets, now it is possible to formulate these tablets with reduced quantity of superdisintegrants. Rapidly disintegrating dosage forms have been. Effectively commercialized by using numerous types of superdisintegrating agents. By the use of many and different types of superdisintegrating agents patient compliance, commercial and therapeutic benefits has enhanced. At a time when researchers are faced with increasing amounts of poorly soluble drugs, it is very important to select superdisintegrating agents that maximize drug dissolution. Due to fast acceptance of RDTs by patients and pharmaceutical companies, the market of this dosage form is growing and the product pipeline quickly, but without the field of superdisintegrating agents it would not have been possible.

Application of Superdisintegrants

Superdisintegrants are used in different types of formulation. These are as follows:

- Mouth dissolving tablet; Khalidindi et al 1982 evaluated soy polysaccharide (a group of high molecular weight polysaccharides obtained from soybeans) as a disintegrant in tablets made by direct compression using lactose and dicalcium phosphate dihydrate as fillers.
- Fast disintegrating tablet; Shirsand et al carried out preparation and evaluation fast dissolving tablets of

metaclopramide using novel co-processed superdisintegrant. In the present study, novel co-processed superdisintegrants were developed by solvent evaporation method using crospovidone and sodium starch glycolate in different ratios (1:1, 1:2 & 1:3) for use in the fast dissolving tablet formulations.

- Rapidly disintegrating tablet; Sandeep B. Patil et al prepared Olanzapine, quick dispersing tablets by direct compression method. Effect of super disintegrant crospovidone on wetting time, disintegration time, and drug content and in vitro release has been studied.
- Pharmaceutical superdisintegrant: Superdisintegrants which provide improved compressibility compared to prior art superdisintegrants. The superdisintegrants include a particulate agglomerate of co processed starch or cellulose and a sufficient amount of an augmenting agent to increase the compatibility of the superdisintegrant.
- Rapidly disintegrating enzyme-containing solid oral dosage compositions: Invention relates to rapidly disintegrating solid oral dosage forms having an effective amount of an enzyme and a superdisintegrant. The enzyme lactase is claimed in this patent for solid oral formulations.
- Fast disintegrating tablets: A fast disintegrating tablet comprising Nimesulide and one or more disintegrants. In this research superdisintegrants

used are croscarmellose cellulose, crospovidone and sodium starch glycolate.

- g) Method of producing fast dissolving tablets: A method of producing a fast-melt tablet. The process does not involve any granulation step, thereby making the process more energy efficient and cost effective. The fast dissolving sugar alcohol is selected from the group comprising: mannitol; sorbitol; erythritol; xylitol; lactose; dextrose; and sucrose. The active component is suitably provided in the form of microparticles or microcapsules having an average diameter of less than 125 microns.
- h) Disintegrating Loadable Tablets: A disintegrating loadable tablet product in compressed form. A disintegrant or a mixture of disintegrants has a) porosity of 45% v/v or more, b) a hardness of at least 20 Newton, and c) a loading capacity of at least 30% of a liquid.
- i) Rapidly disintegrating tablet: The study relates to rapidly disintegrating tablets intended to be used as orodispersible tablets or dispersible tablets. The tablets include silicified microcrystalline cellulose. They are especially suitable for antibiotics. Rapidly disintegrating tablets which contain amoxicillin and clavulanic acid are also described.
- j) Development and Evaluation of orodispersible tablet using a natural polysaccharide isolated from Cassia tora seeds: Orodispersible OF FDT dissolve or disintegrate immediately on the patient tongue or buccal mucosa.
- k) Taste masked microsphere of ofloxacin: Solvent evaporation technique as method for preparation of microsphere.
- l) Enhancement of Loperamide Dissolution rate by Liquisold Compact technique: Enhance the dissolution of Loperamide at Ph values that stimulate the gastric condition so to improve gastric absorption.
- m) Sublingual Fast dissolving niosomal films for enhanced bioavailability and prolonged effect of metoprolol tartarate: Fast dissolving niosomal could be a promising delivery system to enhance the bioavailability and prolong the therapeutic effect of metoprolol tablet.

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