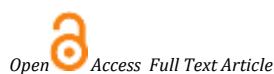


Available online on 15.09.2023 at <http://jddtonline.info>

# Journal of Drug Delivery and Therapeutics

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Review Article

## Immediate-release dosage form; focus on disintegrants use as a promising excipient

Vaibhav Ghansham Kute<sup>1</sup>, Rajeshwari Satish Patil<sup>2\*</sup>, Vaishnavi Ghansham Kute<sup>3</sup>, Priti Dilip Kaluse<sup>4</sup>

<sup>1</sup> Assistant professor, Department of Pharmaceutics, Ojas College of pharmacy, Jalna, Maharashtra, India

<sup>2</sup> Assistant professor, Department of Pharmacognosy, R. C. Patel Institute of Pharmaceutical Education and Research Shirpur, Dhule, Maharashtra, India

<sup>3</sup> Rajarshi Shau College of Pharmacy, Buldana, Maharashtra, India

<sup>4</sup> Ladhad College of Pharmacy Yelgaon, Buldana, Maharashtra, India

### Article Info:

### Abstract



#### Article History:

Received 08 July 2023  
Reviewed 17 Aug 2023  
Accepted 03 Sep 2023  
Published 15 Sep 2023

#### Cite this article as:

Kute VG, Patil RS, Kute VG, Kaluse PD, Immediate-release dosage form; focus on disintegrants use as a promising excipient, Journal of Drug Delivery and Therapeutics. 2023; 13(9):170-180

DOI: <http://dx.doi.org/10.22270/jddt.v13i9.6217>

#### \*Address for Correspondence:

Rajeshwari Satish Patil, Assistant professor, Department of Pharmacognosy, R. C. Patel Institute of Pharmaceutical Education and Research Shirpur, Dhule, Maharashtra, India

Disintegrants are materials or mixtures of substances added in the drug formulations, which make easier dispersion or breakup of tablets and ingredients of capsules in small-scale particles for fast dissolution then it comes in contact with water in the GI tract. Immediate drug release dosage forms disintegrate rapidly after administration with an enhanced rate of dissolution. The superdisintegrants provide instantaneous disintegration of tablets after administration in the stomach. In this field, immediate-release liquid dosage forms and parenteral dosage forms have also been introduced for treating patients. The oral route is the most convenient route for the administration of solid dosage form, about 85% of solid dosage is administered by the oral route because of its advantages over others. The therapeutic activity of these formulations is obtained through a typical manner like disintegration followed by dissolution. Hence disintegration has a major role in facilitating drug activity. Diverse categories of superdisintegrants such as synthetic, semi-synthetic, natural, co-processed blends, multifunctional superdisintegrants, etc. have been employed to develop effectual erodispersible tablets and to overcome the limitations of conventional tablet dosage forms. The objective of the present review article is to highlight the various kinds of traditional, Natural crude drugs containing gum and mucilage, Co-processed, semisynthetic and synthetic disintegrants along with a concentration in tablet and capsule disintegration and effect on drug release, which are being used in the formulation to provide the safer, effective drug delivery with patient compliance. Also highlights the mechanism and use of disintegrants in the immediate release dosage form.

**Keywords:** Disintegrants, Natural, Co-processed, Immediate release

### Introduction:

The excipients are pharmaceutically inactive substances added with active pharmaceutical ingredients during formulation but they have important specific functions and should possess some important requisite features for their functionality. However, the ingredients selected to be pharmaceutical excipients must be physiologically dense or inactive and when incorporated into the dosage form remain physically and chemically stable.

Various excipients used in tablet formulations include disintegrants, fillers, binders, glidants, lubricants, antioxidants, ultraviolet absorbers, dissolution modifiers, absorbents, flavoring agents, colorants, wetting agents, and preservatives. All types of excipient may not be added to a formulation. A good tablet formulation should not be the result of a random combination of excipients with active pharmaceutical ingredients but by a methodical approach with rational excipients selected for providing the most favorable balance combining in the formulation designed interval at providing the desired product performance, manufacturing ability, patient acceptability, cost consideration<sup>1</sup>.

The capability of active substances in a drug to be absorbed by the body depends on its bioavailability. The function of solubility of the active substances in the GIT (Gastrointestinal tract) fluids as the drug passed through the intestines. The solubility depends on the chemical composition and physical form of the APIs (Active Pharmaceutical Ingredients). The rate at which drugs soluble in the biological fluids of the body is affected by the disintegration of the tablet<sup>2</sup>.

A disintegrant is an excipient that is incorporated into the formulation of tablets or capsules to promote their disintegration when they come into contact with liquid or liquid matter. Some types of disintegrant used for many years may be differentiated according to their mode of action:

- Increase the action of capillary forces to promote the absorption of water (by wicking)
- It swells when it goes in contact with water and
- It releases gases leading directly to the disintegration of the tablet.

The general motive of integrating one or more disintegrants in the product formulation is to increase the surface area of the

product and ease the binding matter that detains the solute particles formed the product. The total effect of that tablet when exposed to the aqueous media disintegrates first into granules and into particles. The rate of dissolution in the media enlarges as the particle size decreases and is greatest when the tablets or capsules decrease to particles. Disintegration plays an important role in the development of solid oral, formulator give special emphasis on the selection of disintegrants in the dosage system. Disintegrants are materials or mixtures of substances added in the drug formulations, which make easier dispersion or breakup of tablets and ingredients of capsules in small-scale particles for fast dissolution then it comes in contact with water in the GI tract.

Disintegrants are the main components in a tablet dosage form. It is responsible for ensuring the separation of the tablet matrix. Disintegrants are the substances that cause the fast disintegration of the tablets or capsules into short particles that are soluble faster than in the nonattendance of the disintegrants. Disintegration has a major role in increasing the drug activity, hence it improves the patient acceptability. The pharmacological activity of the design is achieved by disintegration follow by dissolution. The addition of correct disintegrants is to obtain ideal bioavailability in capsules and tablets. Immediate release pharmaceutical dosage forms are those that break down rapidly and get dissolved to release the drug. The rate of drug release or absorption depends on the immediate release of the pharmaceutically acceptable carrier or diluent, which carrier or diluent does not extend, to a considerable prolong.

The immediate-release tablets are disintegrant fast and soluble to release the medication. Immediate release may provide for suitable pharmaceutical passable diluent or transporter, which does not extend and considerably prolong, the rate of drug release and the absorption. A disintegrant is a substance that is put into a capsule or tablet mix to aid in the separation of the dense mass when put into a biological fluid.

## History of disintegrants

Usual disintegrants include cellulose and starch-based excipients like partially pregelatinized starch, corn starch, MCC, and low substituted hydroxypropyl cellulose. A part of clays like Veegum HV, resins like polacrillin potassium, gums like agar, guar, tragacanth, alginate, and finely separated solids like colloidal silicon dioxide, magnesium aluminum silicate are also referred to as disintegrants. Chemical modification of cellulose, povidone, and starch leads to the development of additional systematic disintegrants, capable of good disintegration action at a lot fewer concentrations in the tablet dosage form and it is referred to as superdisintegrants<sup>10</sup>.

The Starch in the form of corn starch and potato has an ordinary and extensively used as a disintegrating agent at the beginning of the 20<sup>th</sup> Century. Natural starches have some limitations as tablet disintegrants, however, and these have stimulated the discovery of modified starches that have more appropriate qualities. The function of starch is by developing water and to a minor extent, their particles become deformed throughout compression and restored on the absorption of water. Starch is a polymer (polysaccharide) of high molecular weight. The starch molecules naturally arrange themselves into crystalline groups or granules of dissimilar sizes that are seen under an optical microscope. According to Lowenthal and Wood, large agglomerates are required for starch to be an effective disintegrant. The present concentration of starch in the dosage form is also important. If the concentration is low, then the starch will produce an inadequate number of passages for wicking of water or body fluid. On the other side, if the concentration is too high, then the medium will be hard

to compress into a tablet. Pregelatinized starch is appeared by the breaking and hydrolyzing of the starch grains. It is widely used as a disintegrant in tablets and capsules, at concentrations of between 5 and 10% by weight. It is more compressible and simply digested in the gut.

The Starch can be chemically altered by carboxymethylation to enlarge cross-linking between molecules. Such modified starch yields a higher degree of swelling when it absorbs water, leading to faster disintegration of the tablet. Sodium starch glycolate is an example of such a starch derivative that can absorb 20 times its weight in water. It is commonly manufactured from potato starch, compares favorably with other modified starches, and is widely used as a disintegrant under the brand names Primojel and Explotab. Redesign starch and its derivatives expand largely with minimal gelling and optimum concentration levels of 46% by weight. When the complete starch forms a sticky and gelatinous situation that steady assists the disintegration process as it assists to hold keep the table particles together. Due to their excessive swelling capacity, the improved starches are highly efficient even in low concentrations<sup>9</sup>.

In 1978, Danti and Bruscatto designate that when the chitin was included in conventional tablets. The tablets disintegrated within 5 - 10 min ignoring the solubility of the drug. The disintegration time in the wetting time, as well as the oral cavity, could be examined by surface free energy. Chitosan is the top natural polysaccharide used in the pharmaceutical industry<sup>23</sup>.

Chitin is mainly obtainable and simply improves, for that reason a promising material that is used as a multifunctional excipient in the dosage form. Chitin is a naturally arising polymer used in dissimilar pharmaceutical applications. The second abundant polysaccharide detected in nature after the cellulose is Chitin. It has been widely studied as a material for multiple purposes in drug delivery and surgical aids.<sup>11</sup>

Chitin structure consists of hydroxyl and amino groups making it the best applicant for chemical modifications in order to enhance its physical, chemical, and biological properties. While chitin and its derivative chitosan are used for controlled drug delivery and very small work have toured chitin as a disintegrant. Bruscatto and Danti invest that chitin can act as a tablet disintegrant at 2-20 % by weight of the formulation and chitin-containing tablets showed compulsive disintegration properties.

## Criteria for Immediate Release Drug Delivery System:

Immediate-release dosage form should be compatible with taste masking in the case of liquid dosage form. It should not leave minimal or no residue in the mouth after oral administration. In the case of solid dosage, it should dissolve or disintegrate in the stomach within a short period. It is having a pleasing mouth feel. It exhibits low sensitivity to the environmental condition as humidity and temperature. Be manufactured using conventional processing and packaging equipment at a low cost. Rapid dissolution and absorption of the drug may produce rapid onset of action. Be portable without fragility concerns.

## Merits of Immediate Release Drug Delivery System:

- Improved stability, bioavailability
- Ability to provide advantages of liquid medication in the form of solid preparation.
- Cost-effective

- Improved compliance/added convenience
- Decreased disintegration and dissolution times for immediate release oral dosage forms;
- Suitable for controlled/sustained release actives
- Adaptable and amenable to existing processing and packaging machinery
- Allows high drug loading.
- Improved solubility of the pharmaceutical composition;

### The disintegration of dosage form depends on various physical factors are as follows:

- The various proportion of disintegrants used in the dosage form.
- According to the formula, the different concentrations of disintegrant present in the formulation.
- Disintegrant use depends on the nature of the drug substance.
- The proportion of disintegrants is used according to the type of mixing and addition.
- The concentration of disintegrants may change due to the hardness of tablet.
- Disintegrants are compatible with other excipients.

### The ideal characteristic of disintegrants: 3

- It should be good compressibility.
- It should be good flow properties.
- It should be a good mouthfeel.
- It has poor water solubility with good hydration capacity and poor gel formation

- It is inert and non-toxic
- It required in the least quantity

Multiple studies investigated the disintegration mechanisms of accessible superdisintegrants such as Crospovidone (CPV) Sodium Starch Glycolate (SSG) and Croscarmellose Sodium (CCS). The proper mechanism of chitin disintegration properties is not well known<sup>12</sup>.

### Mechanisms of disintegration of disintegrants:

5

1. Swelling
2. Wicking
3. Heat of wetting
4. Chemical reaction
5. Particle Repulsive Forces
6. Deformation Recovery
7. By Enzymatic Reaction

#### 1. Swelling of the Disintegrate:

The water introduction is the first step for disintegration, expanding is probably the most everywhere received mechanism of action for tablet disintegrants. Particles of disintegrants expand when coming in contact with particular media and an expanding force develops which produces to separate the matrix. Tablets with large porosity show low disintegration due to a deficiency of sufficient expanding force. On the different side, the enough expanding force is utilized in the tablet with poor porosity. It is expensive in the filling fraction is large and fluid is inadequate to insert in the tablet and disintegration is again displayed down. (Fig. 1).

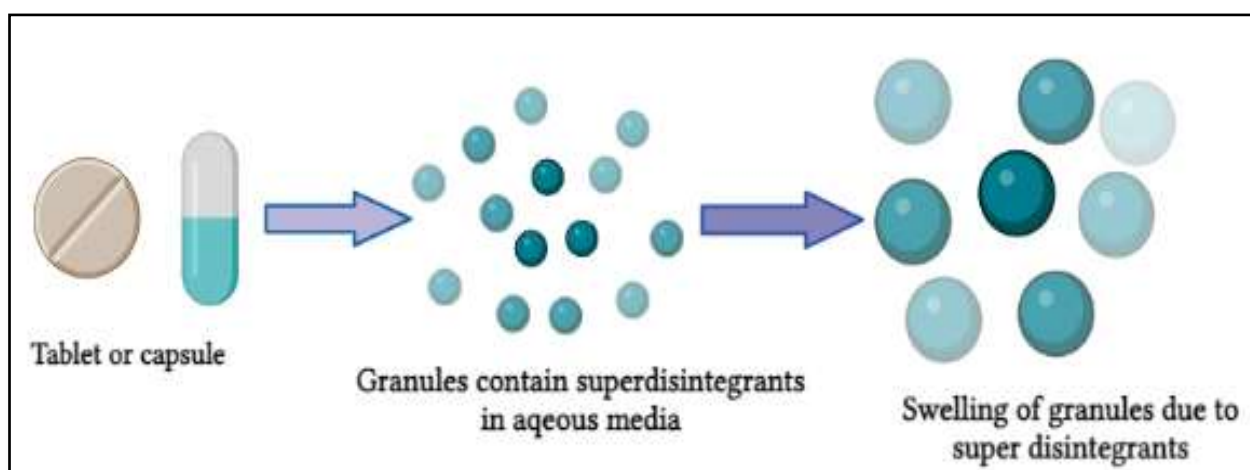


Figure 1: Swelling of the disintegrate

#### 2. Porosity and Capillary Action (Wicking):

Efficacious disintegrants are unable to expand to increase their disintegrating action via capillary action and porosity. The tablet porosity via the other route for the insertion of media in the tablets. When the tablet introduces into suitable media and recovered the air adsorbed on the particles, which

diminishes the intermeddle bond and separates the tablet into very thin particles. Water sucking of tablet-based on the hydrophilicity of the medicament and on tablet state. For this kind of disintegrant maintaining the porous particle and low interfacial tension towards the aqueous media is required which aid in disintegration by producing a hydrophilic network on all side of drug particles<sup>4</sup>. (Fig. 2).

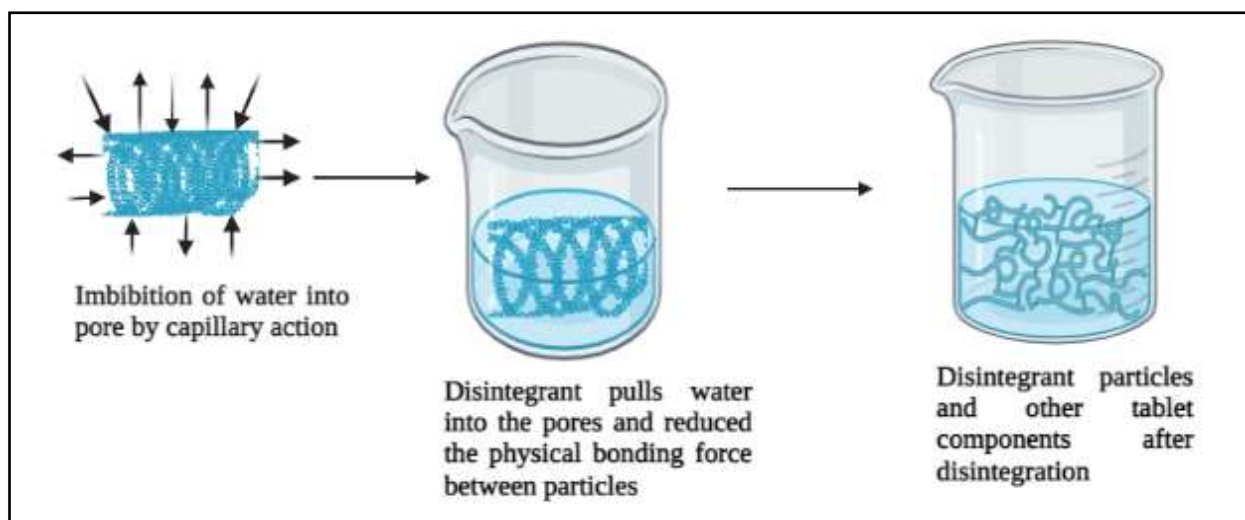


Figure 2: Porosity and capillary action (Wicking)

### 3. Heat of wetting:

When disintegrants have heat exertion properties then they get moistened, and localized stress occurs due to capillary air extension, which assists in the disintegration of the tablet. This simplification, but is limited to some types of disintegrants and can't characterize the action of modern disintegrating agents.

### 4. Particle Repulsive Forces:

Repulsive forces between the particles have another mechanism of disintegration that try to describe the expansion of tablet made with non-expandable disintegrants. According to Guyot-Hermann's particle-particle repulsion theory, when water is inserted into the tablet via the hydrophilic pores of particles then the ceaseless production of the starch network due to the water can supply from one particle to another

particle. The water inserted into starch grains due to the affinity towards starch surfaces, so it has been separating the hydrogen bonding of particles and other forces possess the tablet with each other. The repulsion force in particles is the main mechanism of disintegration and water is necessary for it.

### 5. Deformation Recovery:

Repulsive recovery theory suggests that the morphology of disintegrant particles is twisted during compression. Then particles return to their original shape upon soaking, then these particles are transformed to greater in size than the deformed particles causing the tablet to separate apart. Such an occurrence may be an important aspect of the mechanism of action of disintegrants such as Crospovidone and starch that shows little or no expansion<sup>7</sup>. (Fig. 3).

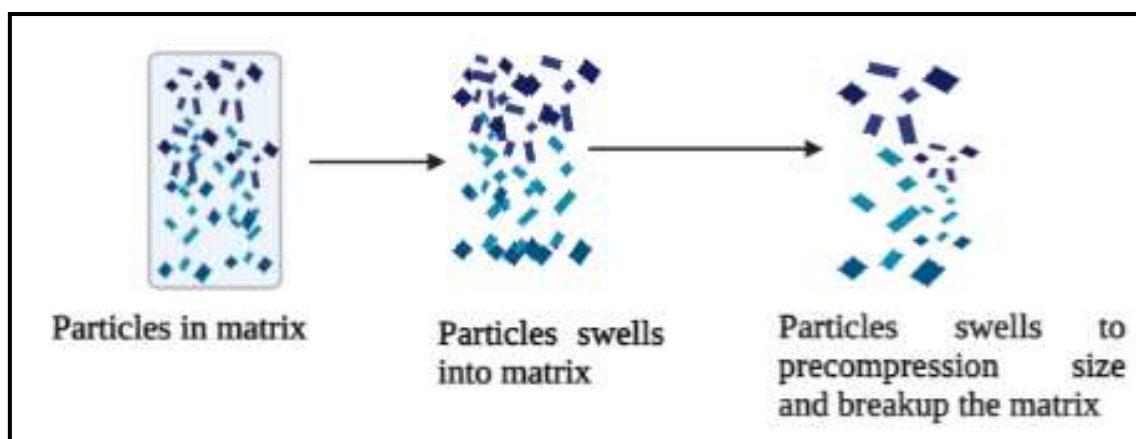


Figure 3: Deformation recovery

### 6. By Enzymatic Reaction:

In our body, there is some enzymes present and they act as disintegrants. These enzymes have the unbreakable action of binder and this enzyme helps in disintegration. When it expands, the pressure is applied in the outside way that causes

the tablet to crack or the accelerated inclusion of water shows a swell in the volume of granules to help disintegration<sup>8</sup>. [Fig. 4]

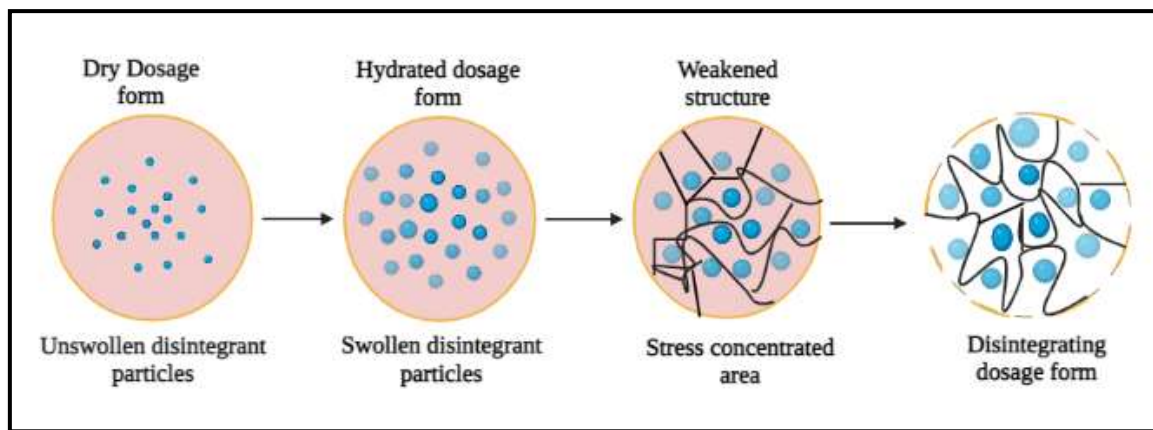


Figure 4: Enzymatic reaction

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

**Types of disintegrants:**

1. Traditional disintegrants
2. Natural disintegrants
3. Synthetic disintegrants
4. Co-processed disintegrants

**1. Traditional Disintegrants:** The traditional natural disintegrants include starch, pregelatinized starch, cellulose, alginate, soy polysaccharides, and chitin are shown in [Table no.- 1].

Table 1: Traditional disintegrants

Sr. No.	Name of traditional disintegrants	Derivatives of disintegrants	Concentration % W/W	Mechanism of action	Ref
1	Starch	Starch USP Pregelatenized starch (1500) Sodium starch glycolate (explotab and primogel)	5-20 5-15 2-8	Swelling when it absorbs water, leading to faster disintegration of the tablet	50
2	Cellulose	Purified cellulose, Methylcellulose Carboxy methylcellulose Microcrystalline cellulose	5-10 2-10 5-10 10-20	ability to swell on contact with water	51
3	Alginate	Alginic acid Sodium alginate	1-5 2.5-10	Acts by swelling Fast wicking rate for water	56
4	Soy polysaccharides	Soy polysaccharides Emcosoy®	5-10	Rapid Dissolving	54
5	Chitin	Chitin and its deacetylated derivative chitosan	2-20	Mechanism of disintegration while dissolution related to swelling capacity.	52

**2. Natural Disintegrants:** The natural disintegrating agents are abundantly available, quite cheaper, non-toxic, and non-irritating in nature over synthetic disintegrants. Natural substances such as mucilage and gums have been broadly used in the field of drug delivery.

For their Eco-friendliness easy availability, emollient and non-irritant nature, non-toxicity, cost-effectiveness, capable of assembling chemical variations, theoretically degradable, and well-matched due to natural origin. There are several

mucilage and gums available which have super disintegrating activity<sup>20</sup>.

The mucilages, glucans, and gums are rich in nature and usually found in several higher plants consisting of polysaccharide hydrocolloids. The polysaccharides consist high concentration of hydroxyl groups. Therefore, it consists of high water binding capacity and this led to studies of their role in plant water relations. The natural mucilages and gums have been extensively discovered as disintegrants. Mucilages and gums are well known for their pharmacological use. In

pharmaceutical industries, the mucilage and gums are used as suspending agents, disintegrants, thickeners, and water retention agents<sup>26</sup>.

**A. Mucilage containing natural drug:** Mucilage is a sticky substance that mostly consists of uranides and proteins, polysaccharides. The concentrated or dried mucilage is known as Gum. The difference between mucilage and gums is mucilages does not soluble in water and gum are soluble in water. The mucilage secreting glands secrete mucilage in the normal growth of the plants<sup>21</sup>.

The Mucilage containing natural drugs shown in [Table no. 2]

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

- Local accessibility.
- Eco-friendly.
- Bio-acceptable.
- Renewable sources and low prices as compared to synthetic products.

**Table 2: Mucilage containing natural drug**

Sr. No.	Biological source	Family	Part of the plant	Chemical constituents	% mucilage	Indications	Ref
1	<i>Hibiscus rosa-sinensis Linn</i>	Malvaceae	Leaves	L-rhamnose, D-galactose, D-galactouronicacid, and D-glucuronic acid	17%	Disintegrant in the fast dissolving tablets by using freely and poorly soluble drug.	22,23
2	<i>Plantago ovata Forsk</i>	Plantaginaceae	Seeds	hydrocolloidal polysaccharide (mucilage), fixed oils, tannin, aucubin glycoside (iridoid), sugars, sterols and protein	20-30%	Binding, Disintegrating and Sustaining properties	24,25,30
3	<i>Lepidium sativum</i>	Cruciferae	Seeds	Dimeric imidazole alkaloids lepidine B, C, D, E and F and two new monomeric imidazole alkaloids semi-lepidinoside A and B.	14-22%	Disintegrating agent	27
4	<i>Trigonella foenum-graecum</i>	Leguminosae.	Seeds	Galactose and mannose	30%	Disintegrant for use in mouth dissolving tablet formulations thickening, stabilizing.	33
5	<i>Cucurbita maxima</i>	Cucurbitaceae	Pulp of fruit	Monounsaturated fatty acids and Poly-unsaturated fatty acids were the most abundant, protein and minerals.	5%	Good disintegrant and it is possible to design promising Fast disintegrating tablet using this polymer	26
6	<i>Ficus indica</i>	Cactaceae	Pulp of fruit	Sacharose, glucose, fructose and	7%	Disintegrant and polymer. Decrease the disintegration time, and provide nutritional supplement.	47
7	<i>Pandalus borealis</i>	Pandalidae	Shells of shrimp	Chitin, a natural polymer of N-acetylglucosamine Chitosan, comprising N-acetylglucosamine and glucosamine	10%	Tablets containing Chitin shows faster disintegration and better dissolution.	28
8	<i>Ocimum gratissimum</i>	Lamiaceae	Seeds	It contain alkaloids, steroid, tannins, flavonoids, hlobatannins terpenoids.	15%	Pharmaceutical adjuvant, specifically a disintegrating agent.	29
9	<i>Ocimum americanum Linn</i>	Lamiaceae	Seeds	It contain alkaloids, steroid, tannins, flavonoids, hlobatannins terpenoids.	14%	It is used as disintegrating agent.	47,55

**B. Gum containing natural disintegrants:** Gums have a tendency to swell in water, therefore it used as disintegrants. They have good disintegration properties in

tablets 2 to 10% w/w concentration of gum must be carefully determined the optimum level for the tablet. The gum containing natural disintegrants show in Table-3.

**Table 3: Gum containing natural disintegrants**

S. N.	Biological source	Family	Part of plant	Chemical constituents	Uses	Ref
1	<i>Pseudomonas elodea</i>	Sphingomonadaceae	Microbe	Monosaccharide $\alpha$ -L-rhamnose, $\beta$ -D-glucuronic acid and $\beta$ -D-glucose	Tablet disintegrant	35
2	<i>Xanthomonas campestris</i>	Xanthomonadacea	Bacterium	Anionic polyelectrolyte with a cellulose backbone with side chains of (3 $\rightarrow$ 1)- $\alpha$ -linked D-mannopyranose, (2 $\rightarrow$ 1)- $\beta$ -D-glucuronic acid, (4 $\rightarrow$ 1)- $\beta$ -D-mannopyranose.	food additive and rheology modifier, commonly used as a food thickening agent and a stabilizer	48,49
3	<i>Cyamopsis tetragonolobus</i> L. Taub.	Leguminosae	Seeds	80% of galactomannan (Guaran), 10% moisture, 5-7% protein	Protective colloids, binding agent and disintegrating agent in tablet formulation	34,36
4	<i>Ceretonia siliqua</i>	Fabaceae	Seeds	Carbohydrates, polyphenolic compounds, especially tannins, dietary fibers	Food industry as a thickening and gelling agent, bio adhesive and solubility enhancement properties.	39,40
5	<i>Sterculia Uren</i>	Sterculiaceae	Stem branches	Chemically the gum has an anionic polysaccharide, consists 43% D-galacturonic acid, 13% D-galactose and 15 percent L-rhamnose.	Binder and disintegrant in the development of conventional dosage form.	36,37
6	<i>Gelidium amansii</i>	Gelidanceae	Red algae	Two polysaccharides as agarose and agarpectin. Agarose is responsible for gel strength and Agarpectin is responsible for the viscosity of agar solutions.	Disintegrant due to its high gel strength. Gums are used in concentration from 1 to 10%.	38
7	<i>Aegle marmelos</i>	Rutaceae	Pulp of fruits	Pulp contains carbohydrates, proteins, O-methyl fordinol and isopentyl halfordinol.	Tablet binder, preparation of uncoated tablet, Immediate release dosage form	43
8	<i>Mangifera indica</i>	Anacardiaceae	Bark	Mangiferin a xanthone glycoside, isomangiferin, tannins & gallic acid derivatives	Binding, sustained release, disintegrating properties an tablets good appearance and better drug release	42,43 10,35
9	<i>Musa acuminata</i> and <i>Musa balbisiana</i>	Musaceae.	Fruits	$\alpha$ -1,4-linked D-galacturonic acid units consist of various sugars such as galactose, rhamnose, arabinose, xylose and glucose.	Superdisintegrant, binder and diluents in pharmaceutical preparations.	31,32 .46
10	<i>Cassia fistula</i>	Leguminaceae	Seeds, Pulp of the pod	Glucoside, barbaloin, aloin, formic acid, butyric acid and their ethyl esters and oxalic acid,	Improve solubility, improve viscosity, superdisintegrant in Fast dissolving table.	44,45

**3. Synthetic disintegrants:** Synthetic disintegrants are frequently used in tablet formulations to improve the rate and extent of tablet disintegration thereby increasing the rate of drug dissolution. The most widely used synthetic disintegrants are illustrated in [Table no.4]

**Advantages of Synthetic disintegrants:** <sup>44</sup>

- Effective in lower concentrations than starch.
- Less effect on compressibility and flowability.
- More effective intra-granularly.

**Limitation Synthetic disintegrants:** <sup>4, 6, 7</sup>

- More hygroscopic (may be a problem with moisture-sensitive drugs).
- Some are anionic and may cause some slight in-vitro binding with cationic drugs (not a problem in-vivo).
- An acidic medium significantly reduces the liquid uptake rate and capacity of sodium starch glycolate and croscarmellose sodium, but not crospovidone.
- The degree of swelling of primojel (sodium starch glycolate) and Polyplasdone XL101 (crospovidone) is minimized following wet granulation formulation. Finally, the medium ionic strength was found to have an adverse effect on the swelling capacity of croscarmellose.

**Table 4: Synthetic disintegrants**

Sr. no	Name of synthetic disintegrants	Properties of disintegrants	Conc. % w/w	Mechanism of action	Brand name	Ref
1	Crospovidone Cross-linked Povidone	It is completely insoluble in water. Rapidly disperses and swells in water. Greatest rate of swelling compared to other disintegrants.  Greater surface area to volume ratio than other disintegrants.  Available in micronized grades if needed for improving state of dispersion in the powder blend.  Swelling index- 58±1.5% v/v.	2-5 %	Water wicking, swelling and possibly some deformation recovery	Cross-povidone M®, Kollidon, Polyplasdone, Polyplasdone XL®, Kollidone CL®	<sup>13,16</sup>
2	Croscarmellose sodium, Crosslinked cellulose	It is insoluble in water, although it rapidly swells to 4-8 times its original volume on contact with water. Specific surface area- 0.810.83 m <sup>2</sup> /g.  Swelling index- 65±1.7% v/v.	2-5 %	Capillary action	Ac-Di-Sol®, Nymce ZSX®, Primellose®, Solutab®, Vivasol®, L-HPC, Nymcel	<sup>14</sup>
3	Modified starch	Absorbs water rapidly, resulting in swelling up to 6%. High concentration causes gelling and loss of disintegration.  Swelling index- 52±1.2% v/v.	5-10%	Rapid and extensive swelling with minimal gelling	Explotab®, Primogel®, Tablo®, Vivastar Starch 1500	<sup>16</sup>
4	Crosslinked alginic acid	Hydrolyzes slowly at room temperature. They are having higher affinity for water absorption and capable for an excellent disintegrants.  Promote disintegration in both dry or wet granulation.	1-5%	Rapid swelling in aqueous medium or wicking action	Alginic acid NF®, Staialgine®	<sup>19</sup>
5	Calcium silicate	Highly porous and have light weight	5%	Wicking	Calcium Silicate	<sup>18,19</sup>
6	L-HPC (Low substituted hydroxyl propyl 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.  Low hydroxyl propyl cellulose are used for rapidly disintegrating the tablet.	1-5%	Swelling action	Grades LH-11 and LH-21 exhibit the greatest degree of swelling.	<sup>19</sup>
7	Resins (Ion Exchange Resin)	Resins although insoluble, have great affinity for water and hence, act as disintegrant.  Smaller particle size the rate of swelling is high making them superdisintegrant.	0.5 to 2%	Swelling action	Amberlite(IPR 88)  Indion 414®, Tusion 339®, Amberlite IRP 88®	<sup>15,17, 18</sup>
8	Acrylic acid derivative	Poly Superporous	0.5-10%	Wicking action	Acrylic acid	<sup>18,19</sup>



**4. Co-processed disintegrants:** Co-processing is based on the novel concept of two or more excipients interacting at the sub-particle level, the objective of which is to provide a synergy of functionality improvement as well as mask the undesirable properties of the individual. Co-processing excipients leads to the formulation of excipient granules with superior properties compared with physical mixtures of components or individual components. The concept of

formulating fast dissolving tablets using co-processed superdisintegrants increases the water uptake with the shortest wetting time and thereby decreases the disintegration time of the tablets by simple and cost-effective (at low concentration of superdisintegrants) direct compression technique.<sup>64</sup> The co-processed disintegrants are shown in [Table No.- 5].

**Table 5: Co-processed Disintegrants**

Sr. no.	Co-processed disintegrants	Method of preparation	Mechanism of action	Concentration	Drug	Ref
1	Corn Starch-Neusilin UFL2 conjugates	Physical, Chemical, and microwave	Wicking, the imbibitions of water into the tablet matrix via capillary action.	2-10 %	Domperidone	<sup>57</sup>
2	Tapioca starch with mannitol	Co-grinding and Co-fusion	Deformation Recovery	2-5 %	Paracetamol	<sup>58</sup>
3	Silicified rice starch	<i>Dioscorea dumentorum</i> Starch is co-processed with silicified rice starch	Deformation Recovery	15 %	Paracetamol	<sup>59</sup>
4	Microcrystalline cellulose and regenerated cellulose	Co-processing method	Ability to swell on contact with water	10-20 %	Metronidazole	<sup>60</sup>
5	Pharmaburst	Sugar alcohols, disintegrants and flow agents	Capillary action	2-5 %	Pitavastatin Calcium and Lornoxicam	<sup>61</sup>
6	PROSOLV® EASYtab SP	Microcrystalline Cellulose Colloidal Silicon Dioxide, Sodium Starch Glycolate, Sodium Stearyl Fumarate	Capillary action	2-5 %	Paracetamol	<sup>62</sup>

## Conclusion:

In summary on disintegrants, it was evident that it plays an important role in the fabrication of solid dosage form. This review has provided the history and types of disintegrants such as traditional, natural, semisynthetic, co-processed, and synthetic. Disintegration occurs with different mechanisms of action, namely swelling, wicking, the heat of wetting, chemical reaction, particle repulsive forces, deformation recovery, and an enzymatic reaction. The immediate-release pellets and/or tablets disintegrate fast and are soluble to release the medication due to the addition of disintegrants in solid dosage forms.

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