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## Applications of the Natural Polymers for Fast Dissolving Tablets

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### Abstract



Oral route is the safest, most convenient, and economical route for administration of different drugs. Oral disintegrating tablets becoming very popular in the current scenario, as they readily disintegrated in mouth within few seconds of the time after its administration without the need of water. Conventional dosage form has a limitations like dysphagia (arduousness in swallowing), in pediatric and geriatric patients, which have been overcome by oral disintegrating tablets. To prepare the same super disintegrating agents plays vital role. Natural Super disintegrants gained an advantage over the synthetic super disintegrants since they are chemically inert, non-toxic, less expensive, easily available, biodegradable in nature. Natural polymers such as locust bean gum, banana powder, pectin from mango peels, as well as the mucilage of Hibiscus rosa-sinensis improve tablet qualities and are used as superdisintegrants, binder, and diluents to speed up the disintegration process as well as improve the solubility of poorly soluble drugs. Natural super disintegrants are obtained from various sources of natural origin, as well as being affordable, nontoxic, biodegradable, environmentally benign, free of negative effects, as well as renewable. From the different extensive literature review, It is observed that based on research showing that natural polymers are more effective and safe than synthetic ones. The goal of the current review paper is to examine the natural polymers that have FDA approval and are used in fast dissolving tablets.

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### INTRODUCTION

FDT can be a helpful substitute when compared to traditional dosage forms. Fast-dissolving tablets are a cutting-edge drug delivery technology that, with or without water intake, quickly dissolves, disintegrates, or disperses the API in saliva. The faster the medicine dissolves in the solution, the quicker it is absorbed and its clinical effects start to manifest. The tablet is one of the most popular oral dose forms. FDT or MDT (mouth dissolving tablets) are examples of novel medicine

administration that have addressed a number of issues, such as dysphagia or restricted access to water when travelling. In order to increase the accessible surface area and encourage a faster release of the pharmacological component, disintegrants are chemicals added to various encapsulated formulations and tablets to encourage the breakage of the tablet as well as capsule "slugs" into more tiny pieces in an aqueous environment. They facilitate the tablet matrix's dispersion as well as moisture penetration. The disintegration of tablets has drawn a lot of attention as a crucial step in achieving rapid medication release. The focus on drug availability draws attention to how crucial it is to determine unrestricted drug dissolving behaviour by using a tablet's comparatively quick disintegration as a criterion. A multitude of factors influence how tablets dissolve and replace themselves. The primary purpose of the disintegrants is to counteract the physical forces that act under compression to form the tablet and the effectiveness of the tablet binder. To get the medication out of the tablet, the disintegrating agents need to be more effective the stronger the binder. The tablet should ideally break apart into the powder particles from which the granulation was made as well as into the granules from which it was crushed. Tablet formulations require disintegrants as a necessary ingredient. For

disintegration to occur, a significant interaction with water is necessary. The disintegrant activity is mediated by a combination of wicking, distortion, and/or swelling. Safer as well as more effective polymers are those derived from natural inchoation. Since they are easily found in natural areas all over the world, they are chosen over manufactured polymers. Natural polymers are used in the majority of preparations and are preferable to synthetic polymers since they are more affordable, easily accessible, and sufficient. Natural polymers are safe for the body and do not cause any harm. Due to their natural ability to biodegrade and lack of contamination, natural polymers are considered environmentally beneficial. Because they come from a natural source, natural polymers have no negative side effects. Patients primarily like natural polymers since they are more patient-complied with, safer, and more effective than synthetic polymers. Natural polymers are renewable since they can be used repeatedly in various processes as well as offer nutritional supplements.

#### Merits:

- You can swallow the tablet without water.
- Patients with mental disabilities, the elderly, and children can all get FDTs with ease.
- More precise dosage than with liquids.

**Table 1 Drugs that can be integrated in fast dissolving tablet**

S. No	CATEGORY	DRUG
1	NSAIDS	Ketoprofen, Piroxicam, Paracetamol,
2	Antiulcer	Famotidine, Lansoprazole
3	Anti-depressant <sup>(7)</sup>	Mitraxepine, Fluoxetine
4	Anti-parkinsonian agent	Bromocriptinemesylate, Lysuride maleate
5	Anti-migraine	Sumatriptan, Rizatriptan, Zolmitriptan
6	Anti-histaminic	Loratadine, Diphenhydramine, Buclizine
7	Hypnotics and sedatives	Zolpidem, Clonazepam
8	Antipsychotics	Olanzapine, Risperidone, Pirenzepine
9	Antibacterial agents <sup>(7)</sup>	Albendazole, Bephenium, Hydroxynaphthoate
10	Anti-arrhythmic agents	Amiodarone, Disopyramide, Flecainide Acetate
11	Anti-epileptics	Beclamide, Carbamazepine, Clonazepam
12	Anti-hypertensive agents	Amlodipine, Carvedilol, Benidipine,
13	Antineoplastic	Aminoglutethimide, Amsacrine, Azathiopnne
14	Anti- fungal agents	Clotrimazole, amphotericin, griseofulvin
15	Cardiac Inotropic agents	Amrinone, Digitoxin, Digoxin
16	Diuretics <sup>(8)</sup>	Acetazolamide, Triamterene, Amiloride
17	Anti-gout agents	Allopurinol, Probenecid, Sulphinpyrazone
18	Anti-muscarinic agents	Atropine, Benzhexol

- The medication dissolves and absorbs quickly, providing a quick start to action.
- Because some medications are absorbed through the mouth, throat, and oesophagus and enter the stomach through saliva, the bioavailability of medications is boosted.
- Better in terms of transportation and administration than liquid medications.
- A lower first pass metabolism results in increased bioavailability, a lower dosage, and fewer side effects, all of which contribute to increased safety.
- Fit for actives with controlled or sustained release.
- Permits heavy drug loading.

**Demerits:**

- Grittiness, residual flavour, or insufficient oral pill disintegration. Fragility and low mechanical strength necessitate cautious handling; dosage formulation is challenging.
- Patients with Sjogren's syndrome and those using anticholinergic drugs may not get the desired breakdown and effects from the tablet because they produce less saliva, which might cause dry mouth.
- Because some FDT are hygroscopic, they cannot maintain their physical integrity at normal humidity conditions and need a particular package.
- FDT are extremely soft and porous, and when they are crushed or moulded into a tablet with little compression, the tablet becomes fragile and tough to handle.

- It is difficult to develop medications with bad tastes like FDT; extra care must be made before formulating such a drug.

**Super disintegrating agents:**

Super disintegrants are added to several Orodispersible tablet technologies that are based on direct compression, as well as their main effect is on the rate of disintegration and hence the rate of dissolve. The breakdown process is further accelerated by the addition of additional chemicals such effervescent agent compounds and water-soluble fillers.

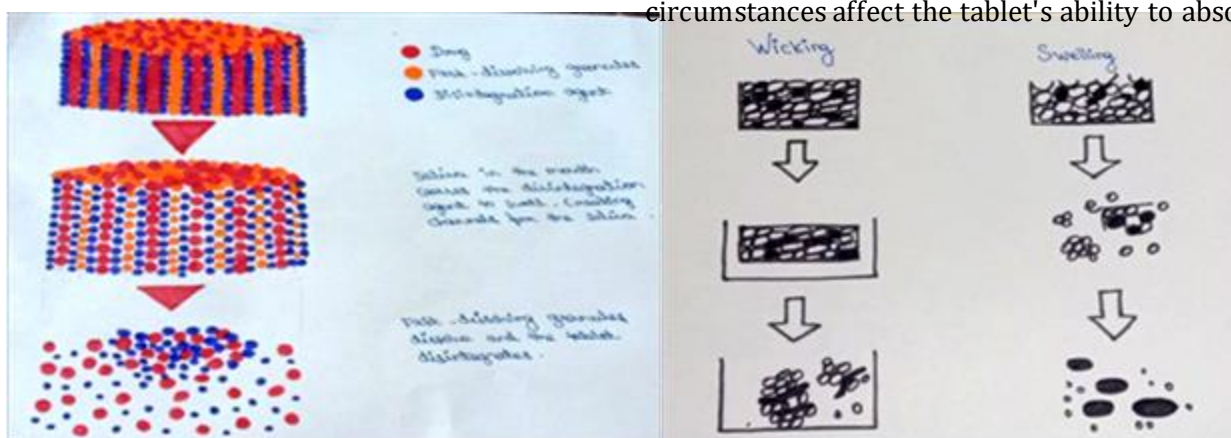
**Mechanism of super disintegrating agents:**

**Swelling:**

Swelling is possibly the general mode of action for tablet disintegration that is most commonly accepted. Because there is insufficient swelling force, tablets with high porosity exhibit weak disintegration. Conversely, the low porosity tablet experiences adequate swelling force. It is important to remember that if the packing percentage is extremely high, liquid cannot pass through the tablet as well as disintegration will again slow down.

**Porosity and capillary action (Wicking):**

The initial stage is always disintegration through capillary action. The tablet fractures into small particles when it is placed in an appropriate aqueous medium because the medium seeps into the tablet and replaces the air that has been adsorbed on the particles, weakening the intermolecular bond. The drug's and the excipients' hydrophilicity as well as the tableting circumstances affect the tablet's ability to absorb

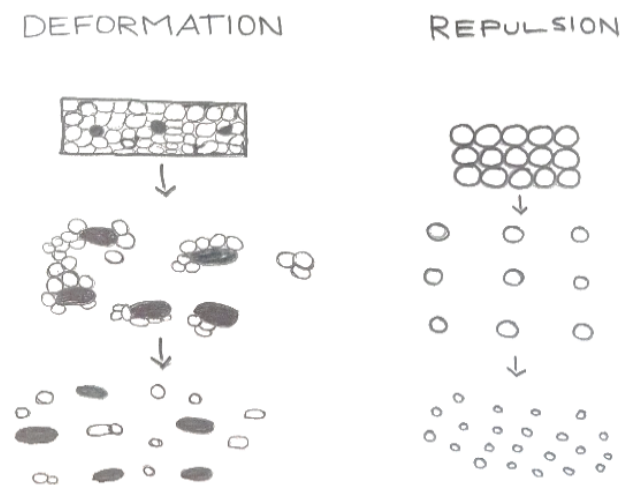


**Figure 1 Mechanism of super disintegrating agents**

water. It is imperative for these disintegrants to maintain a porous structure and low interfacial tension towards aqueous fluid, as this facilitates disintegration by forming a hydrophilic network surrounding the drug particles.

### Due to deformation:

Disintegrated particles undergo deformation during tablet compression; upon contact with water or aqueous fluids, these deformed particles revert to their original structure. Granules that underwent significant deformation during compression occasionally have a higher potential to expand than other types of starch.



**Figure 2 Disintegration through a process of repulsion and distortion**

### Types of Super disintegrants:

- Natural Super Disintegrants
- Synthetic Super Disintegrants

### Natural super disintegrants:

Based on their established safety as well as biocompatibility, natural polymer use is beneficial. Because of their affordability and regulatory approval, natural gums are among the most widely used hydrophilic polymers.

### Guar Gum

*Cyamopsis tetragonoloba* (L) Taub., the plant that yields guar gum, is the source of large molecular weight (about 50,000–8,000,000) polysaccharides made of galactomannans.

It functions as an emulsifying agent, thickening, and stabiliser. This gum is natural and is sold under the trade name Jaguar.

Approved for use in food products, it is a free-flowing, completely soluble, neutral polymer made of units of sugar.

It is not affected by pH, moisture levels, or the solubility of the tablet matrix. It is also not usually perfectly white; occasionally, it is off-white to brown and tends to discolour with time in alkaline tablets.

### Gum Karaya

Gum karaya is a vegetable gum made from the exudate of *Sterculia* trees. Galactose, rhamnose, and galacturonic acid are the sugars that make up gum karaya chemically.

The high viscosity of gum restricts its usage as a disintegrant and binder in the creation of conventional dosage forms.

The potential of gum karaya as a tablet disintegrant has been studied. Various findings indicated that the modified gum karaya causes the pills to dissolve quickly.

Gum karaya is a substitute super disintegrant that is easily accessible, biocompatible, and available in synthetic and semisynthetic forms.

### Agar and Treated Agar

It is the dried gelatinous material that is extracted from various other red algae species, including *Pterocladia* (Gelidaceae) and *Gracilaria* (Gracilariaceae), as well as *Gelidium amansii* (Gelidanceae).

Agar comes in the shape of divests, sheet flakes, or coarse powder. It is yellowish-gray or white to nearly colourless, inodorate, and mucilaginous in taste.

Agarose as well as agar pectin are the two polysaccharides that make up agar. Agar pectin controls the viscosity of agar solutions, while agarose provides the gel's vigour.

### Fenugreek Seed Mucilage

*Trigonella foenum-graceum*, also known as fenugreek. It belongs to the leguminous family of herbaceous plants. Mucilage, a naturally occurring gummy material found in the coats of many seeds, is present in high concentrations in fenugreek seeds.

Mucilage is insoluble in water and solidifies into a sticky, viscous mass when it comes into contact

**Table 2 Various Natural Super Disintegrates with their Disintegration Time**

S. No	Natural Polymer	Drug	Disintegration time
1	Guar gum	Glipizide	60 sec
2	Gum Karaya	Amlodipine	30 sec
3	Gellan gum	Metronidazole	45 sec
4	Fenugreek seed	Metformin	20 sec
5	Soy polysaccharide	Lornoxicam	18 sec
6	Plantago Ovata	Granisetron HCl	17 sec
7	Locust Bean gum	Nimesulide	9 sec
8	Dehydrated Banana Powder	Ondansetron	13 sec

with liquids. When fenugreek seeds come into contact with liquids, they swell up and get slippery. Therefore, the study establishes that fenugreek mucilage, a natural disintegrant, has a more preponderant disintegration property than Ac-di-sol, a synthetic super disintegrant that is commonly employed in FDT formulations.

Research indicated that the mucilage that was removed is a useful disintegration agent as well as medicinal adjuvant.

#### **Gellan Gum**

The bacteria *Pseudomonas elodea* produces the water-soluble polymer gellan gum (17).

There are two main types of gellan gum: low acyl and high acyl acetate groups that are bonded to polymers.

Made as a fermentation product from a pure culture of *Pseudomonas elodea*, galvanic gum is an anionic, high molecular weight, deacetylated exocellular polysaccharide gum consisting of one  $\alpha$ -L-rhamnose, one  $\beta$ -D-glucuronic acid, and two  $\beta$ -D-glucose residues.

#### **Mango Peel Pectin**

The mango, *Magnifera Indica*, belongs to the Anacardiaceae family. Twenty to twenty-five percent of the waste produced during the processing of mangos is mango peel, which is proven to be an excellent source for pectin extraction, fortunate for making films, and acceptable for jelly production.

Pectin is a hydrophilic colloid that is a volute heteropolysaccharide.

#### **Plantago ovata Seed Mucilage**

Indian wheat is the popular name for *Plantago ovata*. For a number of plants in the *Plantago* genus whose seeds are used commercially to

produce mucilage, the common term used is psyllium or ispaghula.

*Plantago Obata's* mucilage possesses a variety of qualities, including binding, dissolving, and supporting qualities.

In one study, the direct compression method was used to quickly dissolve amlodipine besylate tablets, whereas *Plantago ovata* mucilage in varying amounts was used as a natural super disintegrant.

#### **Hibiscus Rosa Sinensis Mucilage and Treated Agar**

Mucilages are used as thickeners, suspending agents, water retention agents, and disintegrants. *Hibiscus* is also known as the shoe flower plant, China rose, and Chinese hibiscus. It is a member of the Malvaceae family.

The plant is easily obtained, and it has mucilage in its leaves that includes L-rhamnose, D-galactose, D-galacturonic acid, and D-glucuronic acid (18).

#### **Dehydrated Banana Powder (DBP)**

Plantain is another name for banana. DBP is a member of the Musaceae family and comes from the banana type known as Ethan and nenthran (nenthra vazha).

Because it includes vitamin A, it is used to cure diarrhoea and stomach ulcers. Due to its high carbohydrate content, it is an excellent source of energy.

It also contains potassium, which is beneficial for more predominant brain activity, and vitamin B6, which helps to lower stress and solicitousness.

#### **CONCLUSION**

Fast-dissolving tablets are more influenced by natural polymers than by synthetic ones. The use of natural polymers as a diluent, as well as binder

super disintegrant, increases the rate of medication release from the tablet while decreasing the time it takes to dissolve and disintegrate. Because they are safe, easily accessible, inexpensive, and naturally extracted to give nutritional supplements, natural polymers are chosen over manufactured ones. Studies have been conducted to compare the dissolving qualities of natural plant materials such as *Plantago ovata*, *Lepidium sativum*, gum karaya, Guar gum, mucilage from fenugreek seeds, pectin from mango peels. As a result, natural super disintegrants have higher bioavailability and quicker drug dissolution, enabling effective therapy and better patient compliance. As a result, tablet formulations can effectively use natural super disintegrants as disintegrants.

### Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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