REVIEW ARTICLE

Superdisintegrants from Natural Origin: An Updated Review

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ABSTRACT

The desire for improved attractiveness in orally administered products has prompted the advancement of various formulations with improved performance and acceptability. Orally disintegrating tablets are an urgent trend in novel drug delivery systems and have received ever-increasing demand during the last few decades. This is accomplished by decreasing the disintegration time, which in turn enhances the drug dissolution rate. Disintegrants are substances or combination of substances enhance to the drug preparation that encourages the breakup or disintegration of tablet or capsule content into smaller particles that dissolve more rapidly. Superdisintegrants are utilized to increase the effectiveness of solid dosage forms. Superdisintegrants are essentially utilized at a lower level in the solid dosage form, normally 1–10% by weight relative to the total weight of the dosage unit. Diverse categories of superdisintegrants such as synthetic, natural, and co-processed blends, etc., have been employed to develop effectual orodispersible or mouth dissolving tablets and to overcome the limitations of conventional tablet dosage form. In recent times there is an extreme demand of the natural superdisintegrants over synthetic or semi-synthetic ones because of their abundant availability, cheaper rates, non-irritating, and non-toxic properties. The current study describes the different superdisintegrants collected from natural origin, which are being used in the formulation to provide safer, effective drug delivery with improved patient compliance.

Keywords: Excipients, Mouth dissolving, Natural, Orodispersible, Superdisintegrants.

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INTRODUCTION

The oral route is the most preferable and convenient route of administration as it offers preference like the simplicity of organization, exceptionally flexible, quite a consistence, and exact dosing.[1] The most prevalent strong structures are being tablets and capsules. One important drawback of these dosage forms for some patients is the trouble to swallow and promptly access to water for simple gulping dosage.[2] Difficulty in swallowing (dysphasia) is also a common problem of all age groups, especially the elderly and pediatrics, because of physiological changes associated with this groups.[3]

The dispersible systems are defined as systems that dissolve or disintegrate within seconds to a few minutes placement. In these cases, the bioavailability of medication from these details may be more noteworthy contrasted with the ordinary oral measurement structures. This creates a porous structure and results in rapid disintegration. The basic technique to grow dispersible tablet involve maximizing the porous structure of the tablet matrix, incorporating the suitable disintegrating agent and utilizing much water-soluble excipients in the formulation, the dispersible tablet can be achieved by different direct compression technique. In this way, the dispersible tablet gives a fast beginning of the activity and counteract hepatic first-pass digestion.

The advantages, as far as patient consistency, the quick beginning of the activity, expanded bioavailability, and great security, make these tablets well known as a dose type of decision in the present market. In spite of expanding enthusiasm for the controlled release framework, the most widely recognized tablet are those planned to be gulped down and to deteriorate and discharge their medicaments quickly in the gastrointestinal tract (GIT). The conventional method used in the preparation of orally disintegrating tablets includes: freeze-drying, tablet molding, spraying, drying, mass extrusion, sublimation, and direct compression.[4-6]

ADVANTAGES OF DISPERSIBLE TABLETS[7]

- It gives quick release from their structure.
- Relatively rapid onset of action can be achieved as compared to the oral route.
- Drugs may be protected from degradation due to pH and GIT enzymes.
- It improves patient compliance due to the elimination of associated pain with injections, administration of

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drugs in unaware or unfitted patients, the convenience of administration as a comparison to injections or oral drugs.
- Drug administration through buccal mucosa is simple.
- The buccal mucosa has a rich blood supply, and drugs can be rapidly absorbed into the circulation system underneath the oral mucosa.
- The enormous contact region of the buccal cavity adds to quick and broad medication retention.
- The patient's observance is more.
- Having a rapid onset of action which may lead to improved bioavailability.
- Patients experiencing issues in gulping tablet can be benefited.
- Useful for pediatric, geriatric, and psychiatric patients.
- Suitable during traveling where water is not available.
- Gives accurate dosing as compared to liquids.
- Good chemical stability.
- Free of the need for excess quantity liquid.

SUPERDISINTEGRANTS

Superdisintegrants essentially influence the pace of deterioration when utilized in normal states. They can likewise influence mouthfeel, tablet hardness just as friability in the event of oral dispersible tablets (ODTs). Disintegration, compatibility, mouthfeel, and flow are the factors considered for choosing a superdisintegrant. Contingent upon the level and qualities of the dynamic pharmaceutical fixing (programming interface) and the ideal discharge profile, the degrees of superdisintegrants utilized can be 10–20% of the total weight, and it may vary in some cases.[8] The water entrance rate and pace of crumbling power advancement are commonly decidedly identified with disintegrant productivity in non-dissolvable frameworks. Be that as it may, such a positive relationship is not constantly seen between tablet disintegration time and drug dissolution rate.[9-13]

Superdisintegrants give fast deterioration because of the joined impact of swelling water retention by definition. Because of swelling of the superdisintegrants, the wetted surface of the bearer builds, this advances the wettability and dispersibility of the system, thus enhancing the capacity to connect firmly with water is basic for disintegrant function. Blends of swelling, as well as wicking and or potentially disfigurement, are the instruments or disintegrant activity. The disintegrants have a noteworthy capacity to restrict the productivity of the tablet fastener and physical power that demonstrate under compression to form the tablet.[14]

Selection Criteria for Superdisintegrants[15]

Despite the fact that the superdisintegrant basically influences the peace of crumbling, when utilized at the abnormal state, it can likewise influence mouthfeel, tablet hardness, and friability.

Hence, a few factors must be viewed as when choosing a superdisintegrants:

Disintegration

The disintegrant should rapidly wick salivation into the tablet to create the volume development and hydrostatic weights important to give quick deterioration in the mouth.

Compact Ability

When assembling an ODT, it is alluring to have tablets with worthy hardness at a given pressure power to deliver strong tablets that keep away from the need to utilize specific bundling while at the same time augmenting generation speed. Accordingly, a progressively compactable disintegrant will deliver more grounded, less friable tablets.

Mouthfeels

To accomplish understanding consistency, ODTs must give an attractive encounter to the patient. Large particles can result in a gritty feeling in the mouth. Thus, small particles are preferred. In the event that the tablet shapes a gel-like consistency on contact with water, in any case, it creates a sticky surface that numerous customers find frightful.

Flow

Likewise, with all immediate pressure tablet definitions, accomplishing great flow and substance consistency is imperative to accomplishing the required dose per unit. In regular tablet plans, superdisintegrants are utilized at 2–5% weight of the tablet plan. With ODT details, disintegrant levels can be essentially higher. At these higher use levels, the vernal factors must be considered when selecting a superdisintegrant. Flow properties of the disintegrant are progressively significant in light of the fact that it makes a more noteworthy commitment to the flow attributes of the total blend. The selection of the optimal disintegrant for a formulation depends on a consideration of the combined effects of all of these factors.[15]

Classification of Superdisintegrant

Based on their source of origin, superdisintegrants can be categorized as shown in the Figure 1[16,17]:

Co-processed Superdisintegrant

Co-processing excipients provide superior property compared to the physical mixture of individual excipient mixture.

Examples of commercially available co-processed superdisintegrants are given in the Table 1.

Synthetic Superdisintegrants

Synthetic superdisintegrants are often utilized in tablet formulation, which facilitates the disintegration of tablets. Examples of synthetic superdisintegrants are given in the Table 2.

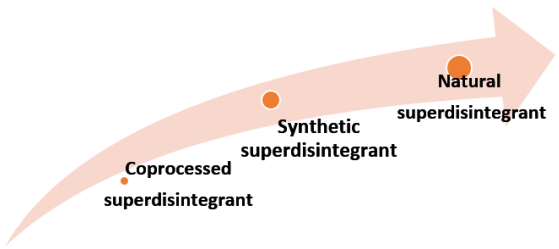

Figure 1: Types of superdisintegrants[16]

Table 1: List of co-processed superdisintegrants

Name of the co-processed superdisintegrants	*Consists of*
Ludipress	Lactose monohydrate, polyvinyl pyrrolidone, 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
Pan Excea MH300G	Microcrystalline cellulose, hydroxyl-propyl-methyl cellulose, and crospovidone
Ludiflast	Mannitol, crospovidone, and polyvinyl acetate

Table 2: List of synthetic superdisintegrants along with their source and mechanism of action

Name of the synthetic superdisintegrant	*Nature*	*Brand available*	*Mechanism*	*Properties*
Sodium starch glycolate/ sodium carboxymethyl starch	Modified starch/ cross-linked starch	Explotab Primogel Tablo Vivastar	Absorb water quickly results in swelling, swells 712 folds in less than 30 seconds	Swells in 3-dimension and high- level acts as a sustained release matrix
Crospovidone	Crosslinked PVP	M kollidon polypiasdone	Combination of swelling and wicking	Water-insoluble, spongy in nature
Croscarmellose sodium	Modified cellulose	Ac-Di-Sol Nymce ZSX primellose solutab vivasol L-HPC	Swelling and wicking within 10 seconds, swells up to 4–8 folds	Swells in 2-dimension
Croslinked alginic acid	–	Alginic acid NF	Rapid swelling or wicking	Promotes disintegration in both dry and wet granulation
Calcium silicate	–	–	Wicking action	Highly porous and have lightweight
Ion exchange resins	Crosslinked polyacrylic	Indion 414 Tulsion 339 Amberlite IRP 88	Swelling	Has high water uptake capacity and high purity pharmaceutical grade weak acid cation resin supplied in dry form

Limitations[16-18]*:*

- Hygroscopic in nature and may cause problems with water-sensitive drugs.
- Some are anionic and may cause some slight *in vitro* binding with cationic medication.
- An acidic medium essentially lessens the fluid take-up rate and limit of sodium starch glycolate and croscarmellose sodium, yet not crospovidone.
- The degree of swelling of primogel (sodium starch glycolate) and polyplasdone XL101 (crospovidone) is minimized wet granulation formulation.
- Finally, the medium ionic quality was found to adversely affect the swelling limit of croscarmellose.

Therefore, natural superdisintegrants serve as a better alternative to overcome the shortcomings of the superdisintegrant.

Natural Superdisintegrants[19]

The natural superdisintegrants include a number of natural elements like mucilage, gums, and other substances that are derived from natural resources. They are extremely gainful at low focuses, which are having high breaking down over synthetic or semi-synthetic substances because of their abundant availability, cheaper rates, non-irritating, and non-toxic property. Agar, karaya gum, and starch previously been utilized in the definition of mouth dissolving tablets. Gums and mucilage arise from natural resources that have been made their own name in the pharmaceutical industry. These are preferred as a thickening agent, emulsifying agents, stabilizing agents, granulator, gelling agent, binding agent, suspending agent, in the formation of the film, super disintegrating agents. The significance of these assets of the normal root is upgrading step by step as the news sources are being created and found. Regular super crumbles are being favored in light of the fact that they are shoddy and effectively accessible and non-aggravation in nature as opposed to manufactured and semi-engineered disintegrants. They are having relieving activity and furthermore have eco-accommodating nature. Natural super disintegrants are useful for chemical modifications, capability degradable and having affinity with others due to their natural sources.

Update on the Various Superdisintegrants from Natural Origin

Aegle marmelos Gum (AMG)

It is obtained from the fruits of *A. marmelos* belongs to the family Rutaceae as shown in the Figure 2 and is indigenous to India. The unripe result of *A. marmelos* (usually known as *bael*) is reported to contain bioactive mixes, such as carotenoids,

phenolics, alkaloids, pectins, tannins, coumarins, flavonoids, and terpenoids.[20] The fruit is edible and has been recommended for use as antiamoebic and antihistaminic agents.[21] The bael organic product gum (BFG) is accounted for to contain a high (54.26% w/w) substance of D-galactose and 20.8% w/w glucuronic corrosive when contrasted with other generally utilized gums. Therefore, BFG can be expected to possess better aqueous solubility and water-retaining capacities due to the presence of high D-galactose content.[22] In addition, *A. marmelos* fruit pectin has been used in a number of foods as a gelling agent, thickener, texturizer, emulsifier, and stabilizer.[23]

Kulkarni U *et al.* formulated aceclofenac rapid dissolving tablets utilizing modified *A. marmelos* gum. Aceclofenac is an ineffectively solvent medication and has poor bioavailability after oral administration. The solubility of aceclofenac was found to be enhanced with an increase in the concentration of AMG and modified AMG. They reasoned that changed AMG could be utilized as a potential determinant in the solvency and disintegration rate improvement of inadequately solvent medication. Increased dispersibility, surface area, wettability, and solubilization effect of AMG and modified AMG enhances the solubility of water-insoluble drugs.[24,25]

Lallemantia reylenne seeds

It is also known as *tukhmalanga* in India, and it belongs to the Lamiaceae family as shown in the Figure 3. It is an annual herb cultivated in Northern India. The seeds are mucilaginous and have medicinal properties.

Malik K *et al*. formulated the orodispersible tablets of nimesulide by using *L. reylenne* seed mucilage as a natural superdisintegrant. They observed a profound increase in tablet porosity and a decrease in disintegration time. The results obtained were better even than that of synthetic superdisintegrants like croscarmellose sodium.[26]

Figure 2: *Aegle marmelos* fruits

Locust Bean Gum

It is also known as carob gum. It is a galactomannan vegetable gum extracted from the seeds of the carob tree (*Ceratonia siliqua*) found in the Mediterranean region region as shown in the Figure 4.

Plant *C. siliqua* Linn. gum contains comprises for the most of an impartial galactomannan polymer made up of 1, 4-associated D-mannopyranosyl units and every fourth or fifth chain unit is substituted on C6 with a D-galactopyranosyl unit. The proportion of D-galactose to D-mannose varies, and this is accepted to be because of the differing starting point of the gum materials and development states of the plant during creation. Being a natural polymer and its thickness and solvency are thusly less influenced by pH within the range of 3 to 11.[27] The physicochemical properties of galactomannan are unequivocally influenced by the galactose content and the dissemination of the galactose units along the primary chain. Longer galactose side chains produce a more grounded synergistic collaboration with different polymers and more noteworthy usefulness.[28] Locust bean gum is an adaptable biopolymer that discovers its different applications in various fields. The ordinary utilization of locust bean gum as an excipient in medication items for the most parts relies upon the thickening, gel-forming, and stabilizing properties.[29]

Figure 3: *Lallemantia reylenne* seed

Figure 4: Locust bean

Malik K *et al*. formulated the nimesulide orodispersible tablets by using locust bean gum as a natural superdisintegrant. The gum was assessed for powder stream properties, swelling list, and misfortune on drying. Excellent powder stream properties were watched; the swelling record was observed to be 20 seconds which shown the apparent capacity of grasshopper bean gum to be utilized as superdisintegrant. Deterioration time of the tablet containing 10% beetle bean gum was observed to be 30 seconds. The tablets disintegrated much faster and consistently when locust bean gum was used as superdisintegrant compared to croscarmellose sodium.[30-32]

Mango Peel Pectin

The common name of *Mangifera indica* is mango, and it belongs to the Anacardiaceae family as shown in the Figure 5. It is non-toxic and utilized as a superdisintegrant, binder, suspending agent, emulsifying agent in various formulations. Mango peel, which constitutes 20 to 25% of the mango handling waste, was observed to be a good source for the extraction of pectin of good quality, felicitous for the preparation of the film, and acceptable jelly. Pectin is an involutes heteropolysaccharide which is a hydrophilic colloid.

Malviya R *et al*. formulated quick-dissolving tablets utilizing mango peel pectin as superdisintegrant. Tablets of mango peel were assessed for weight variety, friability, hardness, thickness, drug content, wetting time, and deaggregation time. The readied tablets had nearly lesser arrival of medication as contrasted and sodium starch glycolate for a particular time frame. In this manner, mango strip gelatin cannot be utilized as promising superdisintegrant; however, because of its great solvency in natural liquid and better swelling list, it tends to be utilized to get ready quick dispersible tablets.[33,34]

Lepidium sativum

It is also called as asaliyo and belongs to the family Cruciferae as shown in the Figure 6. Mucilage is extracted from the seeds of *L. sativum*.

It is generally accessible widely in the market and has minimum effort. Seeds contain a higher measure of mucilage, dimeric imidazole alkaloids lepidine B, C, D, E, F, and two new monomeric imidazole alkaloids semi-lepidinoside A and B. Mucilage of *L. sativum* has different characteristics such as binding, disintegrating, gelling, etc.[35] *L. sativum* is one of the mucilages containing fast-growing edible annual herb.[36]

Mehta KK *et al*. formulated the quick-dissolving tablets of nimesulide utilizing *L. sativum* as a normal breaking down specialist. The readied quick breaking down tablets were assessed for consistency of weight, hardness, tablet thickness, rate friability, wetting time, *in vitro* disintegration time, and *in vitro* dissolution. From this study, it was concluded that the tablet dissolution rate was obtained with an increased concentration of *L. sativum*.[37-39]

Hibiscus rosasinensis Mucilage

It is likewise called a shoe blossom plant, China rose, and Chinese hibiscus having a place with the family Malvaceae as shown in the Figure 7. Mucilages are utilized as thickeners, suspending operators, water maintenance specialists, disintegrants, and so on. The organic soluble plant parts exhibit several characteristics such as anti-inflammatory, analgesic, anti-estrogenic, antipyretic, antispasmodic, antiviral, antifungal, antibacterial, hypoglycaemic, spasmolytic, central nervous system depressant, and many more. However, the water-solvent polymer is left unused and basically goes to waste.[40] The leaves are utilized in traditional drugs as emollients and aperients to treat consuming sensations, skin disease, and constipation.[41] Mucilage of *H. rosasinensis*

Figure 6: *Lepidium sativum*

Figure 5: Mango peel pectin

Figure 7: *Hibiscus rosasinensis*

contains L-rhamnose, D-galactose, D-galacturonic acid, and D-glucuronic acid.[42]

Shah V *et al.* formulated dispersible tablets of aceclofenac and contrasted and various fixations, for example, 2, 4, 6, and 8% (w/w) of *H. rosasinensis* adhesive powder and ac-di-sol®. Eight batches of dispersible tablets were prepared and evaluated for physical parameters like thickness, hardness, friability, weight variation, drug content, disintegration time, and drug dissolution. The figured tablets had a great appearance and better discharge properties. The study revealed that the disintegrant in low concentration (4%) was effective. The mucilage was found to be a superior disintegrating agent than ac-di-sol®.[42,43]

Kalyani V *et al*. formulated and evaluated olanzapine quick release tablets by utilizing natural superdisintegrant. *H. rosasinensis* mucilage and modified gum karaya were investigated. It was observed that formulated tablets had better drug release properties.[44]

Halakatti PK *et al*. formulated and evaluated the mouth disintegrating tablets of famotidine by utilizing *H. rosasinensis* mucilage and treated agar. It was observed that these natural excipients helped a lot to achieve rapid disintegration and rapid onset of drug action in the body.[45]

Dehydrated Banana Powder (DBP)

Banana is also called as plantain. DBP is prepared from the variety of banana called Ethan, and Nenthran (*Nenthravarsha*) belongs to the family Musaceae as shown in the Figure 8. It acts as a binder, diluent, and superdisintegrant. It contains nutrient A, so it is used in the treatment of gastric ulcer and looseness of the bowels. It also contains vitamin B6, which helps to reduce stress and anxiety. It is a very good source of energy due to high carbohydrate content, and it contains potassium, which is responsible for more brain functioning.[46]

Arun N *et al*. formulated orodispersible tablets of ondansetron HCl, propanolol, and gabapectin using DBP as superdisintegrant. The tablets were evaluated for hardness, friability, and wetting time. The results concluded that DBP increases the release of drug from the tablet.[47]

Taksande JB *et al*. formulated and evaluated quick-dissolving tablets of lornoxicam utilizing diverse normal and manufactured superdisintegrant by direct pressure strategy. The natural superdisintegrant banana powder, soy polysaccharide, and synthetic superdisintegrant, crospovidone, were used. It was concluded that tablets prepared by the addition of natural superdisintegrant have less disintegration time, more water absorption, and drug release.[48]

Bharathi A *et al.* formulated characteristic superdisintegrant banana powder in the orally deteriorating tablets utilizing telmisartan as model medication. They contrasted it and other engineered superdisintegrants in the planning of orally deteriorating tablets. It was presumed that banana powder had excellent superdisintegrant property, which can be all around used for growing orally breaking down tablets. Tablets containing banana powder as a disintegrating agent were dispersed rapidly within 15 seconds and showed 92.09% drug release in 15 minutes.[49]

Chitosan and Gum Arabic

Chitosan is a cationic polysaccharide derived from the N-deacetylation of chitin. Gum arabic is a characteristic polysaccharide gotten from the exudates of *Acacia senegal*. Chitosan is shown in the Figure 9. Chitosan has been investigated as an excipient in the pharmaceutical business to be utilized in direct tablet compression, as a tablet disintegrant, for the creation of controlled release solid dosage forms or for the improvement of drug dissolution.[50] Because of its polymeric nature, chitosan has been widely investigated for a variety of micro-particulate pharmaceutical forms. Chitosan is also a candidate for potential applications in the delivery of radiopharmaceuticals, genes, and peptides.[51]

Goel H *et al.* formulated and evaluated rapid disintegrating tablets utilizing interpolymeric chitosan-alginate complex and chitin as novel superdisintegrants. Results recommended that the excipient framework under consideration improved the deterioration time as well as made it conceivable to plan fast dissolving tablets with higher crushing strength.[52]

Nagar M *et al.* formulated cinnarizine orodispersible tablets utilizing chitosan as a natural superdisintegrant. The formulated cinnarizine orodispersible tablets with improved disintegration and dissolution of the drug in the oral cavity and in this manner, better and persistent treatment.[53]

Rishabha M *et al.* formulated quick-dissolving tablets utilization of chitosan gum arabic coacervates as an excipient.

Figure 8: Dehydrated banana powder

Figure 9: Chitosan

The aim of this research work was to synthesize coacervates of two natural polymers, i.e., chitosan and gum arabic. Further, these coacervates were characterized and evaluated as an excipient in fast disintegrating dosage form for the treatment of chronic epileptic attacks. The physicochemical assessment results exhibit that coacervates could be utilized as a pharmaceutical excipient. Thus, coacervates may have a wide range of applications as a polymer in different dosage forms.[54,55]

Plantago ovata

Polysaccharides derived from the husk of *P. ovata* (family: Plantaginaceae) have been classified as superdisintegrant. Psyllium husk contains a high extent of hemicellulose, made out of a xylan spine connected with arabinose, rhamnose, and galacturonic acid units (arabinoxylans). Plantago ovata seed is shown in the Figure 10. The plantago seed comprises 35% solvent and 65% insoluble polysaccharides (cellulose, hemicellulose, and lignin). Mucilage of *P. ovata* has a high swelling index along with various characteristics like binding, disintegrating, and sustaining properties.[56,57]

Mucilage of *P. ovata* is generally collected from the seeds by soaking these for 48 hours in distilled water, followed by boiling for few minutes. Extracted mucilage at a concentration of 2% is found to be a good disintegrant and having the additional advantage of being natural.

Khinchi M *et al*. formulated the orally disintegrating tablets of fexofenadine HCl as model medication by direct compression method utilizing microcrystalline cellulose and mannitol as the straightforwardly compressible vehicle. The tablets were assessed for quality control tests like organoleptic attributes, weight variation, hardness, friability, *in vitro* disintegration time, *in vitro* swelling time, drug content, and dissolution behavior. Among all the superdisintegrants, *P. ovate* mucilage demonstrated the most noteworthy swelling index. Hence the present study revealed that *P. ovata* mucilage as a natural superdisintegrant.[58-60]

Ghenge G *et al.* formulated quick disintegrating tablets of amlodipine besylate utilizing various concentrations of *P. ovata* mucilage as a natural superdisintegrant and reasoned that the dried isabgol mucilage as a superdisintegrant in the tablet is appropriate for the detailing of fast disintegrating tablets.[57]

Shirsand SB *et al.* formulated the disintegrant property of *P. ovata* mucilage in examination with crospovidone in the structure of fast disintegrating tablets of prochlorperazine maleate. Exploratory information revealed that outcomes obtained from the *P. ovata* mucilage were comparable and even marginally superior to those of crospovidone.[61]

Rao NGR *et al.* also formulated and evaluated fast dissolving tablets of carbamazepine utilizing natural superdisintegrant *P. ovata* seed powder and mucilage. It was reasoned that quick-dissolving tablets of ineffectively solvent medication, carbamazepine will prompt expanded bioavailability, improved viability, and thus better understanding consistency by utilizing natural superdisintegrant like *P. ovata* mucilage.[62]

Subhashini R *et al.* formulated and evaluated domperidone quick-dissolving tablets by utilizing *P. ovata* mucilage as a natural superdisintegrant.[63]

Pahwa R *et al.* formulated and evaluated orally breaking down tablets and analyzed the deterioration proficiency of mucilage segregated from natural source, *P. ovata* with synthetic superdisintegrant, sodium starch glycolate in the detailing of orally disintegrating tablets. The study uncovered that mucilage of *P. ovata* demonstrated to be more successful for their disintegrating property than the most commonly utilizing synthetic superdisintegrant.[64]

Sai KV *et al.* prepared orodispersible tablets of sotalol hydrochloride, utilizing various concentrations of natural superdisintegrating agents like *P. ovata* mucilage, synthetic and semi-synthetic superdisintegrants like crospovidone and croscarmellose sodium by direct compression method. Among every one of the details, a definition containing 5% w/w of natural superdisintegrant (*P. ovata* mucilage) was found to be shown faster and high drug dissolution.[65]

Soy Polysaccharide

Soy polysaccharides, *viz*., cellulose, hemicellulose, pectin, gum, and mucilage. Soy polysaccharide is shown in the Figure 11.

Figure 10: *Plantago ovata*

Figure 11: Soy polysaccharide

It polysaccharide has been used in dietary enhancements because of high fiber content. The polysaccharide, which is sourced from dehulled and defatted soybean flakes, is delicate white to light-tan fibrous powder and does not contain starch or sugar. It has 75% dietary fiber with the fundamental parts, including five types of the higher commercial version of the soy polysaccharide (emcosoy®) is being utilized as a superdisintegrant in compressed tablets.[66]

Halakatti PK *et al*. formulated 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. A crosslinked sodium carboxymethyl cellulose and corn starches were used as control disintegrants. Soy polysaccharide performs well as breaking down operator in direct compression formulations with results paralleling those of crosslinked CMC.[67]

Hosny KM *et al.* formulated and evaluated simvastatin orodispersible tablets containing soy polysaccharide as a novel superdisintegrant. Orodispersible tablet indicated least wetting and disintegration time, faster water absorption rate, and the highest dissolution rate.[68]

Gunjal S *et al.* formulated and evaluated amlodipine besylate orally disintegrating tablet using natural superdisintegrant, soy polysaccharide, and synthetic superdisintegrant, croscarmellose sodium. They inferred that upgraded breaking down of the tablet was maybe because of the joined impact of swelling and wicking properties of soy polysaccharide and croscarmellose sodium.[69]

Gellan Gum

Gellan gum is obtained from *Pseudomonos elodea* as shown in the Figure 12. It is an immediate anionic polysaccharide biodegradable polymer involving a straight tetrasaccharide repeat structure and is utilized as a sustenance included substance.

Antony P *et al.* formulated gellan gum as a superdisintegrant, and the effectiveness of gum is contrasted with other conventional disintegrants, for example dried corn starch, explotab, avicel (pH 102), ac-di-sol, and kollidon CL. The breaking down of the tablet maybe because of the quick swelling attributes of gellan gum when it comes into contact with water and inferable from its high hydrophilic nature. The total breaking down of the tablet is seen inside 4 minutes with gellan gum concentration of 4% w/w and 90% of drug dissolved within 23 minutes. Ac-di-sol and kollidone CL shows a 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 as a superdisintegrant.[67]

Figure 12: Gellan gum

Shah DP *et al.* utilized a more current use of physically adjusted gellan gum in tablet formulation utilizing the factorial structure. They inspected the physically changed gellan gum in tablet formulation as a superdisintegrant. It was observed that modified gellan gum has superior swelling ratio than pure and optimized batch reveals excellent disintegration time.[70]

Prajapati ST *et al.* formulated and evaluated sublingual tablets of zolmitriptan used direct compression technique. clusters arranged with gellan gum.[71]

Fenugreek Seed Mucilage

Trigonella Foenumgraceum (Leguminous family)) as shown in the Figure 13 is an herbaceous plant. It has discovered wide applications as a nourishment, a sustenance added substance, and as a conventional prescription. The leaves and both the ready and unripe seeds of *T. Foenumgraceum* are utilized 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, diarrhea, gout, and diabetes. It is also used as gastroprotective, antiurolithiatic, diuretic, anti-dandruff agent, anti-inflammatory agent, and an antioxidant. The seed is expressed to be a tonic. It additionally is utilized in post-natal consideration and to build lactation in nursing mothers. Fenugreek seeds contain a high level of mucilage (a natural sticky substance present in the coatings of numerous seeds). In spite of the fact that it does not break up in the water, mucilage forms a viscous tacky mass when presented to liquids. Like other mucilage containing substances, fenugreek seeds swell up and become smooth when they are presented to liquid. The subsequent delicate mass is

Figure 13: Fenugreek seed

not consumed by the body; however, rather goes through the digestion tract and triggers intestinal muscle contractions.[67] Kumar R *et al.* formulated and evaluated the disintegrant properties of fenugreek seed adhesive. Studies uncovered that fenugreek mucilage indicated better disintegrating property than the most widely used synthetic superdisintegrants like ac-di-sol in the formulation of fast disintegrating tablets.[72]

Sukhavasi S *et al.* formulated and evaluated quick-dissolving tablets of amlodipine besylate by utilizing fenugreek seed mucilage and *Ocimum basilicum* gum as natural superdisintegrants. The tablets disintegrated much faster and consistently when fenugreek seed mucilage and *O. basilicum* gum were used as superdisintegrant as compared to synthetic superdisintegrants.[73]

Kumar MU *et al.* prepared and evaluated quick-dissolving tablets containing diclofenac sodium utilizing fenugreek gums as natural superdisintegrant. The study uncovered that the fenugreek gum as a natural superdisintegrant indicated preferred breaking down property over the most broadly utilized synthetic superdisintegrants like sodium starch glycolate and croscarmellose sodium in the formulation of quick-dissolving tablets.[74]

Guar Gum

Guar gum is a galactomannan, generally utilized in beautifying agent, nourishment item, and in pharmaceutical formulations. It is shown in the Figure 14. Guar gum, for the most part, comprises of the high molecular weight (approximately 50,000–8,000,000) polysaccharides made out of galactomannans and is obtained from the endosperm of the seed of the guar plant, *Cyamopsis tetragonalobus* (L) Taub. (synonym *Cyamopsis psoraloides*). It is used as a thickener, stabilizer, and emulsifier and approved in most areas of the world (e.g., EU, USA, Japan, and Australia).[75] Its synonyms are galactosol, guar flour, jaguar gum, meprogat, and meyprodor. It has likewise been researched in the planning of sustained-release matrix tablets in the place of cellulose derivatives such as methylcellulose. In pharmaceuticals, guar gum is utilized in strong measurements shapes as a binder and disintegrant, and in oral and topical items as suspending, thickening, and stabilizing agent, and also as a controlled-release carrier. Guar gum has also been examined for use in colonic drug delivery.[76,77]

Sharma R *et al.* formulated the impact of starch and guar gum 4,000 on disintegrating time and dissolution behavior of drug zolmitriptan from quick-dissolving tablets. Tablets were prepared by the direct compression method. Studies uncovered that when guar gum (5%) and starch (10%) were utilized in detailing, the plasma concentration of drugs was expanded on the ground that it disintegrates tablet quickly, and the drug was discharged quickly from dosage form.[78]

Agar

Agar is the dried coagulated substance gotten from *Gelidium amansii* (Gelidanceae) and a couple of various sorts' red algae like gracilaria (gracilariaceae) and pterocadia (gelidaceae). Agar is shown in the Figure 15. Agar is yellowish dark or white to almost colorless, scentless with mucilaginous taste and is accessible in the form of strips, sheet flakes or coarse powder. Agar comprises of two polysaccharides as agarose and agaropectin. Agarose is in charge of gel quality, and agaropectin is in charge of the thickness of agar solutions. It is a potential contender to about as a disintegrant because of its high gel strength. Gums are utilizing in concentration from 1 to 10%. However, these are not as good disintegrating agents as others because capacity development is relatively low.[79]

Sharma V *et al.* formulated orodispersible tablets of roxithromycin, adjusted polysaccharide by utilizing agar as fast disintegrating excipient. Results showed that adjusted polysaccharide exhibited the least disintegration time. Hence, the approach of using modified polysaccharides as fast disintegrating excipient can be used to formulate a stable orodispersible formulation.[80]

Peter R *et al.* formulated rapid dissolving tablets of flunarizine hydrochloride by sublimation method utilizing camphor and menthol as sublimating agents and treated agar as superdisintegrant. It was presumed that detailing indicated the greatest drug discharge within 90 seconds. Rapid dissolving tablets of flunarizine hydrochloride by sublimation method utilizing menthol as a sublimating agent and treated

Figure 14: Guar gum

Figure 15: Agar

agar as superdisintegrant can be used for better patient compliance.[81]

Prakash P *et al.* formulated, evaluated, and improved piroxicam fast dissolving tablets utilizing treated agar as natural disintegrant. The impact of the disintegrant concentration on the release of piroxicam was considered. *In vivo* disintegration time of tablets was observed to be less than 60 seconds *in vitro* dissolution profile demonstrated a faster and maximum of 99.3% drug release proving the disintegrating property of treated agar gum.[82]

Cucurbita maxima Pulp Powder

It is commonly known as pumpkin, belongs to the family Cucurbitaceae as shown in the Figure 16. It is indigenous to South America. The study revealed that *C. maxima* pulp powders have comparable dissolution behavior to that of sodium starch glycolate. It also has the same hardness and friability, thus, it stands as a disintegrant and polymer in fast-dissolving tablets.[82]

Malviya R *et al.* carried of the evaluation of Cucurbita with diclofenac sodium and prepared various concentrations of 2.5, 5, 7.5, and 10%, and these also sent for various tests like friability drug content, drug disintegration time. This study also proves that this is a good pharmaceutical adjuvant and disintegrating agent.[67]

Aloe Vera

Aloe vera obtained from leaves of *Aloe barbadensis* Miller belongs to family Liliaceae as shown in the Figure 17. Fast dissolving tablets offer the combined advantages of performance, convenience, rapid onset of action, and patient compliance and permit administration of an oral solid dose form without water or fluid intake. At the point when set on the tongue, it crumbles promptly, discharging the medication which breaks down or scatters in the salivation. They are set up by systems, for example, tablet forming, spray drying, lyophilization, sublimation, or expansion of disintegrants. Pharmaceutical formulators frequently face the test of finding the correct blend of definition factors that will create an item with ideal properties.[83-87]

Panigrahi R *et al.* formulated fast dissolving tablets of lisinopril by direct compression method using aloe vera gel, *P. ovata,* and *Hibiscus rosasinesis* as natural superdisintegrants. It was concluded that *in vitro* disintegration time was reduced, and *in vitro* release was significantly improved.[88]

Cassia fistula

Seeds of *C. fistula* gum obtained from *C. fistula* tree belongs to family Caesalpiniaceae as shown in the Figure 18. Gum

Figure 17: Aloe vera

Figure 16: *Cucurbita maxima* pulp powder

Figure 18: *Cassia fistula*

obtained from the seeds of *C. fistula* contains β (1→4) connected d-mannopyranose units with an arbitrary circulation of α (1→6) connected d-galactopyranose units as a side chain. Carboxy methylation, just as carbamoylethylation of cassia gum, is accounted to improve cold-water solubility, improve viscosity, and increase microbial obstruction when contrasted with local gum. Therefore, an endeavor was made to consolidate calcium or sodium salts of carboxymethylated or carbamoylethylated *C. fistula* gum as a superdisintegrant in the formulation development of FDT.[67]

Rai PR *et al.* formulated superdisintegrating properties of calcium crosslinked *C. fistula* gum derivatives for fast-dissolving tablets. Disclosures demonstrated mind-blowing potential for utilizing calcium salts of carboxymethylated or carbamoylethylated derivatives of *C. fistula* as super-disintegrants in rapidly disintegrating tablets with high mechanical strength and low disintegration time.[89]

Cassia tora

C. tora gum got from the seeds of *C. tora* Linn. is a typical herbaceous yearly happening weed all through India.[90] *C. tora* is shown in the Figure 19. *C. tora*, a well known Indian therapeutic plant, has long been utilized in *Ayurvedic* system of medicine. The plant has been found to have various numbers of pharmacological activities like laxative, skin diseases, eye diseases, liver grievance, dysentery, and antihelminthic. Different exercises, for example, cancer prevention agents, hypoglycaemic, hypolipidemic, antifungal, antiplasmodic, antimicrobial hyperlipemia, and hypotensive have likewise been accounted for.[91]

Pawar H *et al.* formulated and evaluated orodispersible tablets utilizing natural polysaccharide detached from *C. tora* seeds. The report uncovered that *C. tora* seed polysaccharide has good potential as a disintegrant in the formulation of orodispersible tablets.[92]

Garg V *et al*. formulated fast disintegrating tablets of glibenclamide to improve tolerant consistence. Rapid disintegrating tablets were prepared to utilize natural superdisintegrant *C. tora* and *P. ovata* by direct compression method. They concluded that the fast-dissolving drug delivery system of glibenclamide could be successfully formulated.[93]

Ocimum americanum seed mucilage

Seed mucilage from *Ocimum americanum* belongs to family Lamiaceae is shown in the Figure 20.

Figure 19: *Cassia tora*

Patel M *et al*. formulated the propanolol hydrochloride tablets using *Ocimum americanum* seed mucilage using various concentrations like 2, 4, 6, 8, and 10% the optimum concentration of mucilage for rapid dissolution is shown at 10%, and the same concentration with starch and propanolol 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.[67]

Sharma A *et al*. formulated the impact of mucilage of *O. basilicum* on the formulation of rapid disintegrating tablets of lamotrigine and contrasted it and distinctive novel synthetic superdisintegrants. *O. basilicum* seeds mucilage was additionally described based on its organoleptic properties, micromeritic properties, along with melting point and solvency assurance. They uncovered that it is conceivable to get the rapid onset of action of the antiepileptic drug lamotrigine and, in this manner, can control the genuine epileptic convulsions in the minimum time.[94]

Hardikar S *et al*. formulated fast disintegrating tablets of paracetamol by utilizing the dried mucilage isolated from the seeds of *O. basilicum*. Fast disintegrating formulations were prepared by utilizing established disintegrants and dried mucilage as a novel disintegrating agent. The tablets prepared by utilizing dried mucilage as a disintegrating agent resulted in fast disintegration of the tablet equivalent to build up disintegrants.[95]

Panda BP *et al.* formulated diclofenac sodium orodispersible tablets with natural disintegrants seed mucilage of *P. ovata* and seed mucilage of *O. basilicum* utilizing reaction surface strategy. Streamlining thinks about by numerous relapse examinations uncovered that 6% of *P. ovata* and 5% of *O. basilicum* was found to be optimum, which has disintegration in 36 seconds, and cumulative drug release was 99.2% at 25 minutes.[96]

Gum Karaya

Gum karaya is commonly known as Indian tragacanth. It is a vegetable gum as shown in the Figure 21 produced as exudates

Figure 20: *Ocimum americanum* seed

Figure 21: Gum karaya

Figure 22: Groundnut

Figure 23: Pectin

by trees of the *Sterculia urens*. Chemically, gum karaya is an acid polysaccharide composed of the sugars, galactose, rhamnose, and galacturonic acid. The high thickness nature of gum restrains its uses as binder and disintegrant in the advancement of the conventional dosage form. Gum karaya has been researched for its potential as a tablet disintegrant.

Various outcomes demonstrated that modified gum karaya produces rapid disintegration of tablets. Gum karaya can be utilized as an alternative superdisintegrant to commonly available synthetic and semi-synthetic superdisintegrants due to its low cost, biocompatibility as well as facile availability.[67] Bansal N *et al.* formulated and evaluated orally disintegrating tablets of ondansetron hydrochloride utilizing modified gum karaya and modified natural agar as natural superdisintegrants. Results demonstrated that modified gum karaya and modified natural agar produce fast disintegration of tablets.[97]

Groundnut (Peanut) Shells Powder

Ground nut is shown in the Figure 22. Shells were crushed in the grinder and then passed though #60 mesh. The characterization of GNSP the different phytochemical tests and flow property investigation of just groundnut (peanut) shells powder was carried out.

Harrell *et al.* studied to use the GNSP as superdisintegrant and formulate the fast dissolving tablet at low cost and by avoiding the synthetic superdisintegrants.[98]

Pectin

A pectin is a group of galacturonic corrosive rich polysaccharides, including homo galacturonan as shown in the Figure 23. Pectin is basically and practically the most intricate polysaccharide in plant cell dividers.

Mohnen *et al.* studied pectin works in plant development, morphology development, and plant guard and furthermore fills-in as a gelling and stabilizing polymer in differing sustenance and claim to frame items and effectively effects on human health and various biomedical uses.[98]

CONCLUSION

With the increasing demand for novel drug delivery, the fast disintegrating drug delivery systems have become one of the milestones of present investigations**.** Superdisintegrants develop the faster drug release rate from the tablets and lower the disintegration time. Although a variety of materials are available to serve as superdisintegrants in the design of dispersible tablets, the use of natural superdisintegrants for fast disintegration of tablet structure is always an area of active research despite the advent of synthetic superdisintegrants. In recent times natural superdisintegrants continue to gain profound attractiveness as they are readily accessible in nature, relatively inexpensive, products of living organisms, readily undergo *in vivo* degradation, non-toxic, and capable of chemical modifications. They have an important role to play in the pharmaceutical industry. Therefore, in the years to come, there is going to be continued interest in the natural superdisintegrants to have better materials for pharmaceutical purposes.

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