COMPREHENSIVE OVERVIEW OF NATURAL SUPERDISINTEGRANTS

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<td>Of all the dosage forms administered orally, orodispersible drug delivery system (ODDDS) is a novel drug delivery system which has plenty of advantages over other orally administered formulations. ODDDS is convenient to manufacture and easy to administer as it is not required to be taken along with water, offering rapid release, increased bioavailability and free from side effects. The polymers which are obtained from natural origin being biocompatible as well as biodegradable are more efficient and safe. Natural polymers are cheaper, non-irritating and non toxic in nature. They are abundantly available in nature throughout the world and hence more preferred than synthetic polymers. Natural polymers like locust bean gum, banana powder, mango peel pectin, psyllium and <em>Hibiscus rosa sinenses</em> mucilage improves the properties of tablet and these excipients have been utilized as binder, diluent, and superdisintegrants. These materials increase the solubility of poorly water soluble drugs to some extent, reduce the disintegration time, and support the nutritional supplement. The aim of the present review article is to give comprehensive overview of the natural polymers that have been utilized in the development of orodispersible tablets.</td>
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INTRODUCTION
Orodispersible tablet (ODT) is solid unit dosage form containing medicinal substances that disintegrates rapidly and dissolves in the mouth as soon as it come in contact with saliva. Hence, these formulations do not need water or chewing for disintegration of the formulation [1,2]. Due to fast conversion of drug into solution form, quick absorption of drug takes place and rapid onset of action is achieved. Thus, pre gastric absorption of drug takes place which avoids first pass metabolism, resulting in better blood plasma concentration with enhanced efficacy. This makes it suitable formulation for drugs which undergo extensive pre-systemic metabolism [3].

After administration, ODT must turn into soft mass or liquid form. This task can be included in the dosage form by adding right disintegrants which play an important role in formulation of orodispersible tablet. Addition of disintegrants in ODT causes quick disintegration of tablets and thus enhances dissolution [4].

Salient features of ODTs: [4-5]
ODT shows advantages of both liquid dosage form and conventional tablet formulation. It also has additional advantage over both these dosage forms which includes-

1. **Accurate dosing:**
   Being unit solid dosage form ODTs provides accurate dosing, permits high drug loading and also act as best alternative for pediatric and geriatric patients.

2. **Rapid action:**
   As these tablets get rapidly disintegrated, it offers rapid onset of action with quick dissolution and absorption in oral cavity. Hence, it is useful in cases such as motion sickness, migraine attacks etc.

3. **Improved bioavailability:**
   More rapid drug absorption from mouth, pharynx and esophagus enhances the bioavailability of the drugs due to avoidance of hepatic metabolism.

4. **Improved palatability:**
   ODTs leave behind, minimum or no residue at all in mouth. Pleasant mouth feels property can be produced by using flavors and sweeteners which helps to mask the bitterness of drugs.
especially in pediatric population. Now days, various techniques of taste masking were developed which enhances the palatability of bitter drug.

5. **Obstruction free:**
As ODTs are disintegrated in mouth cavity no risk of suffocation in airways due to physical interference when swallowed, therefore it provides better safety and patient compliance.

6. **Ease of administration:**
ODTs are advantageous for patients who have difficulty in swallowing such as the elderly, strokes victim and bedridden patients; patients who should not swallow, such as renal failure patients and who refuse to swallow such as pediatrics, geriatrics and psychiatric patients.

7. **Patient compliance:**
ODTs do not require water to swallow and they can be taken anywhere at any time. Thus it is better option for travelling patients and busy peoples who do not have instant access to water; hence patient compliance is improved.

8. **Simple packaging:**
ODTs are packed in simple push through blister packaging and hence no need of costly and specific packaging and it makes ODTs economical.

**Disintegrants and their role [6, 7]:**
Disintegrating agent is one of the unavoidable ingredients utilized in the formulation of tablets and some of encapsulated dosage form, to promote the break–up of the compacted mass into small fragments so that the active ingredients could be released. During disintegration process, the disintegrant increases the available surface area when it is comes in contact with a fluid environment. They intensify the penetration of moisture and thus dispersal of the tablet matrix is achieved. The important function of the disintegrant is to combat the efficiency of the tablet binder and physical forces that act under compression to structure the tablet. Tablet disintegration is a crucial step in producing instant drug release (Fig. 1). The disintegrant interacts with water to break or disintegrate the tablet.
Currently, chemically modified disintegrant, called as superdisintegrants have been developed to augment the disintegration process. Superdisintegrants are modified version of super absorbing materials with convenient swelling properties. These materials are planned to swell very fast. These materials get enlarged when come in contact with wet environment. These recently developed substances are more robust, at lower concentration having improved disintegrating efficiency and mechanical strength.

**Ideal characteristics of superdisintegrants [6]:**

1. It should be non toxic.
2. Should have good flow property.
3. Should give good compatibility & compressibility.
4. Should be effective in less quantity.
5. Should have pleasant mouth feel.

**Mechanism of disintegration by superdisintegrants [4, 6, 8-9]:**
Various mechanisms are involved in the disintegration of solid oral dosage form that contains superdisintegrants. These mechanisms are as follows

1. **Swelling:-**
   Swelling in all likelihood, is one of the most widely accepted mechanisms of disintegration. When such disintegrating agents come in contact with water and get swell and adhesiveness of other ingredients like binders is overcome. In this mechanism the disintegrating agents swelling property (e.g. starch) contributes to disintegrating effect. Thus, tablets matrix breaks into small fragments. The process is shown in Fig. 2.
   E.g. Sodium Starch Glycolate

   ![Figure 2: Mechanism of disintegration by Swelling](image)

2. **Wicking (porosity and capillary action):**
   Certain effective disintegrants does not swell when brought in contact with water. Such disintegrant leads to the disintegration of tablets by means of porosity and capillary action. Porosity of tablets creates pathways for the penetration of fluid into tablets. The disintegrating
fractions which have low compactness and compressibility themselves act to increase porosity and provide the pathways into the tablet. Liquid is picked up or “wicked” into these pathways with the help of capillary action and breaks the inter-particulate bonds resulting into the tablet disintegration. The mechanism is depicted in Fig. 3.

e.g. Crosscaramellose.

![Figure 3: Mechanism of disintegration by Wicking](image)

**3. Deformation:**

Disintegrant particles get distorted during the process of tablet compression and the distorted particles regain their normal structure when they come in contact with water or aqueous environment. It results into enlargement of distorted particles which causes the tablet disintegration. Such a process may be an important aspect of the mechanism of disintegrants which shows little or no swelling. The mechanism is expressed in Fig. 4.

e.g. Crosspovidone
4. **Particle repulsive forces:**

This is one of the mechanisms of disintegration which explains the swelling of the tablet prepared with non-swelling disintegrant. As per Guyot-Hermann’s particle-particle repulsion theory, the water penetrates into tablet through hydrophilic pores and a substantial hydrostatic pressure is imparted. Thus, weakening of hydrogen bonds between particles takes place resulting in the disintegration of the tablet (Fig. 5). The electric repulsive forces between particles are the driving force for the disintegration of tablet and water is required for the same.
5. **Enzymatic reaction:**

Enzymes present in the body help in disintegration. These enzymes decrease the binding action of the binder and lead to disintegration. Due to uptake of the fluid, swelling pressure is raised in tablet metrics which is exerted in external direction. This process results in splitting of tablet or the accelerated absorption of water leads to drastic increase in the volume of granules to cause disintegration.

**Natural materials used as Superdisintegrants [6, 7]:**

The natural materials such as gums and mucilages have been broadly used in the field of drug delivery as they are abundantly available, cost-effective, eco-friendly, emollient and non-irritant, non-toxic, are capable of a multitude of chemical modifications, and potentially degradable and biocompatible.

**Advantages of excipients of natural origin [6]:**

1. The excipients which are obtained from natural origin are more efficient and safe.
2. Natural materials are cheaper as they are abundantly available in nature and hence more preferred over synthetic materials.
3. These are non-irritating and non-toxic in nature.
4. These are inherently biodegradable and biocompatible.
Although there is no ideal superdisintegrant having all optimal characteristics, currently marketed superdisintegrants shows an excellent combination of properties which can be integrated for development of orodispersible dosage forms. There are diverse varieties of gums and mucilage which possesses superdisintegrant activity [4-7]. The details of these superdisintegrants are given in the following section.

**Superdisintegrants from natural origin used in ODTs:**

1. **Psyllium**:-

Psyllium or Isapghula is the established name used for numerous members of plant which belongs to genus *Plantago* whose seeds are commercially utilized for production of mucilage. Psyllium mucilage comes from the seed coat of *Plantago ovata* by mechanical milling of the outer layer of seeds. It has been investigated for its versatile characteristics like binding, disintegrating and sustaining properties. Due to the very high swelling index, it is advantageous to use this mucilage as superdisintegrants for formulating ODTs [10-12].

Draksiene *et al.* studied the application of a natural superdisintegrant, psyllium husk powder for the manufacturing of orodispersible Meloxicam tablets. Meloxicam was chosen as a model drug for the study. ODTs were prepared by direct compression method using different concentration of psyllium husk. It was observed that, psyllium husk powder significantly increased the rate of disintegration of Meloxicam. Researchers concluded that the effects may be attributed to the rapid uptake of water due to the vigorous swelling ability of psyllium husk powder and thus the powder could be recommended as an effective natural superdisintegrant for Orodispersible formulation [13].

Khinch *et al.* emphasized on the study of disintegrating property of mucilage, Husk powder and seed powder of *Plantago ovata*. They prepared ODT of Fexofenadine HCl (as model drug) by direct compression method using microcrystalline cellulose and Mannitol as direct compressible vehicle. Developed formulations were evaluated for quality control tests like organoleptic characteristics, weight variation, hardness, friability, *in-vitro* disintegration time, *in-vitro* swelling time, drug content and dissolution behavior. Swelling index was also investigated with an aim to compare the swelling property of seed powder, husk powder and mucilage. It was found that, among all the superdisintegrants, *Plantago ovata* mucilage showed the highest swelling index [14].
2. Fenugreek:

*Trigonella Foenum-graceum*, well known as Fenugreek, is an herbaceous plant belonging to family *Leguminaceae*. This plant is very commonly cultivated and has wide applications as a traditional medicine in various regions. Fenugreek seeds contain high % of mucilage in its coating and thus can be used as superdisintegrant for ODTs. It does not dissolve in water but forms viscous slippery mass when come in contact with fluids. Similar to other mucilage, it swells when exposed to fluid environment and thus shows superdisintegrant property. Studies showed that the extracted mucilage is a good pharmaceutical excipient, especially as a disintegrant [10, 15].

Sharma *et al.* designed *in-vitro* study for comparing the effect of natural superdisintegrant with synthetic superdisintegrants and conventional superdisintegrants in the fast dissolving tablet formulation of Domperidone. This group prepared various tablet formulations using four different superdisintegrants namely- fenugreek seed mucilage, sodium starch glycolate, Crosscaramellose sodium with three concentrations (2%, 4%, and 6%) by direct compression method. The tablets were evaluated for post-compression parameters like thickness, drug content, hardness, weight variation, wetting time, friability, disintegration time, dissolution time and drug release study. Formulation 8 containing fenugreek seed mucilage 4% showed the lowest disintegration time and *in vitro* dissolution studies i.e. 99.50% drug release at the end of 3 minutes [16].

Hazare *et al.* formulated fast dissolving tablet of valsartan using freeze-dried fenugreek seed mucilage as disintegrant. Fast dissolving tablets of valsartan were prepared by direct compression using different concentrations of fenugreek gum and *Ocimum tenuiflorum* gum as a natural superdisintegrants and compared with synthetic superdisintegrants like crospovidone. The formulated tablets were evaluated for various post compression parameters like friability, weight variation, and hardness. *In vitro* dissolution study showed 93.32% and 91.46% drug release, 42, and 53 seconds disintegration time for tablets prepared using fenugreek and *Ocimum tenuiflorum* gum respectively. Based on the outcome of the evaluation parameters, researchers concluded that natural gums like fenugreek and *Ocimum tenuiflorum* have better disintegration properties with improved disintegration time, when used in combination with synthetic disintegrants [17].
3. **Guar Gum:**

Guar gum obtained from the seeds of *Cyamopsis tetragonolobus* belonging to family *leguminoseae*, is a naturally occurring galactomannan polysaccharide. It is free flowing; completely soluble natural polymer consisting of sugar units. This natural polymer has high molecular weight. It shows superior disintegration property as compared to common disintegrants such as corn starch, cellulose, alginates and magnesium aluminium silicate. Its disintegration property changes according to particle size. The finer particle shows greater disintegration efficiency [7, 18-19].

Sunitha *et al.* formulated taste masked fast disintegrating tablets of Captopril by direct compression and evaluated it for the palatability and bioavailability of the drug. Taste masking of Captopril was achieved using β-cyclodextrin as a complexing agent. Guar gum was used as natural superdisintegrant in different concentration (2.5 to 10 mg). The optimized formulation showed drug release of 99.86±0.54 % within 12 min and disintegration time 50.16±1.32 sec. From this study the researchers concluded that the formulated tablets of Captopril containing guar gum of concentration 10 mg (optimized batch) was better and effective than conventional tablets to meet patient compliance along with fast relief from hypertension [20].

Sharma *et al.* studied the effect of starch and guar gum 4000 on disintegrating time and dissolution behavior of drug, Zolmitriptan, from fast dissolving tablet. They tablets were prepared by direct compression method and evaluated for post-compression parameters like thickness, uniformity of content, hardness, friability, wetting time and *in vitro* disintegration time and *in vivo* drug release. The *in vivo* study revealed that when guar gum (5%) and starch (10%) were used in formulation, the plasma concentration of drug was increased because, it disintegrates the tablet rapidly and drug was released rapidly from dosage form and reach quickly in to systemic circulation leading to increase in the bioavailability [21].

4. **Gellan Gum:**

Gellan gum is a polysaccharide produced by bacterium, *Pseudomonas elodea*. It is a linear, water soluble polysaccharide. It is biodegradable, high molecular weight deacylated polysaccharide produced as a fermentation product by a pure culture of Pseudomonas elodea. It is composed of tetrasaccharide recurring unit of L-rhamnose, d-glucuronic acid and d-glucose. Gellan gum shows gelling property in presence of mono and divalent cations. Gellan
gum exhibit greater swelling ability when it comes in contact with wet environment which may be due to its highly hydrophilic nature. The disintegrant action of gum might be due to these characteristics [19, 22, 23].

Antony et al. studied that the gellan gum as a superdisintegrant and the efficiency of gum is compared with conventional disintegrants such as dried corn starch, explotab, avicel (pH 102), Ac-di-sol and Kollidon CL etc. It was observed that the instantaneous swelling of gellan gum took place when it came in contact with water which might be due to its high hydrophilic nature. Complete disintegration of tablet was observed within 4 mins with gellan gum concentration in the formulation of 4 %w/w and 90 % of drug dissolved within 23 min. Based on the outcome of their research, they proved gellan gum as a excellent superdisintegrant [24].

Shah et al. examined the physically modified gellan gum in tablet formulation i.e., as a superdisintegrant. They formulated tablets containing modified gellan gum using $3^2$ randomized full factorial designs. It was observed that optimized batch shows excellent disintegration time (155 s), and % drug release in 2 and 5 min were 39 and 78%, respectively. They concluded that there were no chemical interactions while only physical modification and modified gellan gum can work as a superdisintegrant [25].

5. Gum Karaya:-

Gum Karaya also known as Indian gum tragacanth, is a vegetable gum obtained as an exudate from trees of the genus *Sterculia* belonging to family *sterculiacaeae*. Gum karaya is an acid polysaccharide consisting of galactose, rhamnose and glucuronic acid. As gum karaya is highly viscous its use as a binder and disintegrant is limited in production of conventional dosage form. But if some modifications are done on gum karaya, it shows rapid disintegration of tablets. Gum karaya has low cost as it is abundantly available in nature. Also it is biocompatible hence it can be used as an alternative superdisintegrant to commonly available synthetic and semi synthetic superdisintegrants [10, 26].

Sukhavasi et al. formulated fast dissolving tablets of amlodipine besylate using different concentrations (2, 4, 6, 8, 10) of natural superdisintegrant viz; *Hibiscus Rosa – sinensis* mucilage and modified gum karaya. It was observed that formulation of *Hibiscus rosa – sinensis* mucilage (FHR5) and modified gum karaya (FMGK5) showed shorter disintegration time and 100% release. Hence, they concluded that this natural superdisintegrants (*Hibiscus rosa – sinensis*
mucilage and modified gum karaya) proved to be better disintegrant compared to synthetic superdisintegrants [27].

6. **Locust Bean gum:**

Locust Bean gum, better known as carob bean gum, is structurally similar to guar gum. It is obtained from the endosperm of the seed of *Ceratonia siliqua* Linn. belonging to family *leguminosae*. Locust bean gum is a hydrocolloidal polysaccharide having a high molecular weight (3, 10,000). Chemically, gum contains high-molecular-weight hydrocolloidal polysaccharides, composed of galactose and mannose units combined through glycosidic linkages. Plant seed contains a neutral polymer galactomanan which is slightly soluble in cold water. Heating of dispersion is required for achieving full hydration, solubilization and building high viscosity. The beans or brown pods of locust bean tree are treated by milling the endosperms to form locust Bean gum. Thus, it is a flour rather than extract of the plant. The color of gum varies from white to yellowish white; it is an odorless powder. It has been investigated for bioadhesive and solubility enhancement properties. Locust Bean gum is used as a gelling and thickening agent in pharmaceutical as well as in food industry [12, 22, 28].

Malik *et al.* formulated nimesulide orodispersible tablets using locust bean gum as a natural superdisintegrant. The gum powder was evaluated for flow properties, swelling index and loss on drying. The gum showed excellent powder flow properties; swelling index was found to be 20 which indicated appreciable capability of locust bean gum to be used as superdisintegrant. The prepared tablets were evaluated against standard superdisintegrant i.e. croscarmellose sodium. The disintegration time of tablets containing 10 % locust bean gum was found to be 13 seconds. The prepared tablets were evaluated for wetting time, water absorption ratio, effective pore radius, porosity, *in vitro* and *in vivo* disintegration time, *in vitro* release and stability studies. Wetting time was found to reduce from 19 +/- 2 to 11 +/- 3 sec (A1-A4) and 51 +/- 2 to 36 +/- 3 sec (B1-B4). They concluded that the superdisintegrant property of locust bean gum may be due to concentration dependent wicking action leading to formation of porous structure which disintegrated the tablet within seconds [29].

Singh *et al.* prepared the fast disintegrating tablet of Amlodipine besylate using two different classes of super-disintegrating agents; natural (Locust bean gum; *Plantago ovata*) and synthetic
(Crocarmellose sodium, Crospovidone) by direct compression. The tablets were evaluated according to the parameters in the pharmacopeia. It was observed that fast disintegrating tablets prepared with Locust bean had the highest drug release \textit{(in-vitro)} of 98% within 30 min. They concluded that Locust bean gum can be used as a superdisintegrant for rapid release of drug [30].

7. **Aegle marmelose gum:-**

Gum is obtained from fruits of *Aegle marmelos* belonging to family Rutaceae. It has been investigated that this gum offers faster and consistent disintegration as compared to croscarmellose sodium. The matured fruit pulp is red in color. This pulp is having mucilaginous and astringent taste. The fruit pulp is composed of carbohydrates, proteins, Vitamin C, Vitamin A, angelenine, marmeline, dictamine, O-methyl fordinol, and isopentenyl halfordinol. *Aegle marmelose* gum is prepared by utilizing the heat treatment technique. It enhances the solubility of poorly soluble drugs. Purified, gum polysaccharide contains D-galactose (71%), D-galacturonic acid (7%), L-Rhamnose (6.5%), and L-arabinose (12.5%) [31, 32].

Dev et al. used modified *Aegle marmelos* gum as natural superdisintegrant and assessed it in terms of various parameters to confirm its suitability in preparing fast dissolving dosage form. They extracted the gum from *Aegle marmelos* fruit. The gum was modified chemically by carrying out its carboxymethylation and further complexed with Calcium chloride. Therefore, the natural Superdisintegrant prepared from *Aegle marmelos* gum followed swelling and wetting mechanism for disintegration of the dosage form. They prepared dummy tablets containing calcium complexed *Aegle marmelos* gum to check the disintegrating efficiency of the tablets. The disintegrating properties of calcium complexed *Aegle marmelos* gum as superdisintegrant were compared with the marketed superdisintegrant Sodium starch glycolate. The disintegrating time for calcium complexed *Aegle marmelos* gum was found to be 1min ±2sec to 1min ± 5sec showing good disintegrating properties. They concluded that this study may serve as a prototype approach for formulation and development of novel superdisintegrant from various natural gums [33].

8. **Chitin and Chitosan:-**

Chitin is a naturally existing polymer of N-acetyl, D-glucosamine. It is found in the shells of crabs, crayfish, shrimps and other crustacean. Commercially, Chitin is obtained from crustaceans by
treatment of acid to dissolve calcium carbonate. Then by alkaline extraction the proteins are solubilized. By partial deacetylation of Chitin, Chitosan can be obtained. Chitosan is having multifarious applications in pharmaceutical industries. After cellulose, Chitosan is the most abundantly available natural polysaccharide. It has been utilized to develop ODTs because of its superdisintegrant property. Chitosan, similar to other superdisintegrants, absorbs water when come in contact with aqueous environment and tablet burst due to hydrostatic pressure exerted. Thus spontaneous disintegration of dosage form is commenced resulting in formation of uniform dispersion which acts as a true suspension formed within the body leading to the rapid and complete absorption of drug [34, 35].

Olorunsola et al. evaluated callinectes chitosan as a superdisintegrant in metronidazole tablet. They incorporated superdisintegrants into tablets at concentrations below 5% of tablet weight to prompt break-up of tablets after administration. The polymer characterized and then used as a disintegrant (in comparison with Ac-Di-Sol® and corn starch) at concentrations of 2, 4 and 8% for the formulation of metronidazole tablets. It was found that there was no adverse interaction between the chitosan and metronidazole. The disintegration times of tablets containing 2, 4 and 8% chitosan were found 12.2, 10.4 and 9.3 min respectively. They concluded that callinectes chitosan is suitable for use as a superdisintegrant in tablets and is superior to corn starch as disintegrant although less effective compared to Ac-Di-Sol [36].

9. **Agar and treated agar:**

Agar is the procured from *Gelidium amansii (Gelidaceae)* and several other species of red algae like *Gracilaria (Gracilariaceae)* and *Pterocladia (Gelidaceae)* in the form of dried gelacious substance. It is yellowish grey or white to nearly colourless depending upon the shape and the form. It is found in various forms like strips, flakes, sheets or coarse powder. It is not solubilized in cold water; but if it is boiled with water and cooled then it gets converted into a getinous mass. It is also insoluble in organic solvents.

Agar is composed of two different polysaccharides known as agarose and agaropectin. Agaros is responsible for gel strength of agar and is composed of the D-galactose and 3-6 anhydro L-galactose units. It consists of about 3.5% cellulose and 6% of nitrogen containing substances. The viscosity of agar solution is due to the presence of agaropectin. It is a sulphonated
polysaccharide in which galactose and uronic acid units are partially esterified with sulphuric acid. Due to high gel strength, agar plays an important role as a disintegran[9, 10, 37]. Pankaj Bhardwaj et al. developed ODT of Metformin hydrochloride using agar as natural superdisintegrant to improve bioavailability, disintegration time, dissolution efficacy and patient compliance. It was found that formulation with 6% super disintegrant had better results as compared to other formulations. The disintegration time and percentage drug release was found to be 11.03 sec and 98.5% (in less than 30 min) respectively [38].

10. Mango peels pectin:-
Mango processing contains 20-25% of mango peel as waste, which is a good source for the extraction of pectin having good quality. The major component of pectin is a linear polysaccharide composed of α-1, 4 linked D-galactouronic acid along with branched regions. Pectin is reported to play a major role of adjuvant in preparation of film and acceptable jelly. The pectin is easily soluble in water and this property contributes to fast release of the drug from the tablet matrix. Altogether, it has higher swelling index which make it useful in the formulation of ODTs [39, 40]. Malviya et al. carried out extraction and evaluation of mango peel pectin as superdisintegrant agent. They prepared tablets of Diclofenac sodium using mango peel pectin and observed that tablets had comparatively lesser drug release as compared to sodium starch glycolate for a specific period of time. Therefore, they concluded that mango peel pectin cannot be used as a promising superdisintegrant, but due to its good solubility in biological fluid and better swelling index, it can be used to prepare fast dispersible tablets [39]. Shirsand et al. prepared and evaluated fast dissolving tablets of furosemide with a view to enhance patient compliance and minimize the side effects. In this study fast dissolving tablets of furosemide were formulated by direct compression method using pectin of mango peel (mangifera indica) as natural disintegrants and crospovidone as a synthetic superdisintegrant for comparison purpose. The prepared formulations were evaluated and it was found that among all the formulation, the formulation containing 8% w/w pectin of mango peel showed better drug release and disintegration time as compared to tablets prepared from other natural and synthetic disintegrants (50%, 5.2 min) [41].
11. *Lepidium sativum* mucilage:-

Natural *Lepidium sativum* (*family-Cruciferae*) also known as Asaliyo has extensive application as herbal medicine and disintegrating agent in pharmaceutical field. It is available in market on large scale and has very low-cost. Seeds constitute a higher portion of mucilage around the outer layer, dimeric imidazole alkaloids, lepidine B, C, D, E and F and two new monomeric imidazole alkaloids, semilepidinoside A and B. The mucilage can be obtained from seeds by using different procedures and its yield obtained varies from 14-22%. Mucilage of *Lepidium sativum* has versatile characteristics like binding, disintegrating, gelling etc. So it is widely use as an adjuvant in pharmaceutical dosage forms. The mucilage is extracted from seeds and is utilized to formulate ODTs. Mucilage is brownish white color and it gets degraded above 200 °C temperature [42, 43, 44].

Wadetwar et al. investigated *Lepidium sativum* Linn seeds mucilage as a natural superdisintegrant in ODTs. They prepared Promethazine HCl ODTs using different concentrations of (8%, 10%, 12% and 15%w/w) of isolated mucilage from *Lepidium sativum* Linn seeds (natural) and Croscarmellose sodium (synthetic) as superdisintegrants by direct compression method. The dispersion time and *in vitro* drug release of the optimized formulation were compared with marketed orodispersible tablets of Promethazine HCl. The characterization and *in-vitro* release profile of prepared ODTs showed that the formulated Promethazine HCL tablet F3 containing 12% mucilage was effective and suitable than marketed tablet because it has better dispersion time 29 sec and maximum % cumulative drug release i.e. 98.87%. They concluded that isolated mucilage from *Lepidium sativum* Linn seeds has a good potential to enhance *in vitro* dispersion time and *in vitro* drug release of ODT of Promethazine HCl [45].

Kaur et al. prepared fast dissolving tablets of Aceclofenac by direct compression method using different concentrations of *Lepidium sativum* mucilage as natural superdisintegrant. A two-factor three-level (32) factorial design was used to optimize the formulation. Formulation D5 was selected as optimum batch Formulation according to Design-Expert software which exhibited DT (15.5 sec), WT (18.94 sec), and *in vitro* drug release (100%) within 15 mins. [46].
12. **Hibiscus-rosa sinensis mucilage**:-

*Hibiscus rosa sinensis* linn (family- *Malvaceae*) is better known as shoe flower, China rose and Chinese hibiscus. The mucilage is collected from fresh leaves of *Hibiscus rosa sinensis* has been found to play role as superdisintegrant. The leaves of Hibiscus contain carotene, moisture, proteins, fats carbohydrates, fibres, calcium and phosphorus. The contents of mucilage are L-rhamnose, D-galactose, D-galactouronic acid and D-glucuronic acid. Mucilage are prominently utilized as disintegrants, suspending agents, water retention agent, and thickening agent. The percent yield of mucilage from leaves was found to be about 17% [47, 48].

Surya Kumari *et al.* studied the disintergant property of *Hibiscus rosa-sinensis* mucilage using Imipramine as a model drug. They developed fast dissolving tablet of Imipramine using natural disintegrant isolated from Hibiscus *rosa sinensis* leaves. The efficiency of natural disintegrant was compared with synthetic superdisintegrant like crosspovidone. The *in vitro* disintegration time of tablet formulations containing 6% of mucilage was found to be 24 sec and that of tablet containing 4% of crosspovidone was 42 secs. [49].

13. **Ficus indica fruit mucilage**:-

The mucilage obtained from the pulp of fruit *Ficus Indica* can be utilized as superdisintegrating agent in pharmaceutical dosage form. *Ficus indica* is very large tree up to 3 meter and very fast growing plant, with spread branches and aerial roots. The size of *Ficus indica* fruit is near about same to that of cherry fruit. These fruits have medicinal value in addition to nutritional value. The dried and uncooked *Ficus indica* fruit gives 230 kcal of energy per 100 gram. It is utilized in getting relief from pain, fever inflammation, wound rejuvenating, blood quandaries and urinary quandaries [7, 48].

14. **Soy polysaccharide**:-

Soy polysaccharide is a natural superdisintegrant that does not contain any starch or sugar, therefore can be used in nutritional products. Halakatti *et al.*, 2010, investigated that soy polysaccharide (a group of high molecular weight polysaccharide obtained from Soyabean) shows disintegration property parallel to cross-linked CMC, when used as a disintegration agent in tablet made by direct compression utilizing lactose and dicalcium phosphate dihydrate as fillers [42, 50, 51].
Khaled Hosney et al. prepared Sildenafil citrate (SC) as a sublingual tablet utilizing soy polysaccharide as novel superdisintegrant. The tablet containing 8% soy polysaccharide as a superdisintegrant showed wetting time of 25 sec, and in vitro dispersion times of 55 sec. The drug release was found to be 95.6%. The prepared SC sublingual tablet also exhibited a rapid onset of action, and its bioavailability was enhanced 1.68-fold compared with that of the marketed tablets [52].

15. **Dehydrated banana powder (plantain):**

Bananas are a highly nutritious fruit and have many medicinal properties beyond their nutritive value. Banana powder is mainly comprised of polysaccharide, ascorbic acid amines, citric acid etc. The dehydrated banana powder (DBP) is made from the banana specifically, from the variety called Ethan or Nenthran belongs to family musaceae. It is a natural and largely used nutritional supplement because it contains multiple essential nutrients including minerals and vitamins. Fully ripened banana pulp contains, 33.6% reducing sugar, 53.2% sugar, 5.52% proteins, 0.68% fats, 0.3% fibres, 2.6% starch and 4.09% ash [53, 54].

Bharathi et al. introduced and evaluated natural excipient (banana powder) that has versatile property in the ODTs using Telmisartan as model drug. They developed ODTs of Telmisartan with natural disintegrating agent like banana powder and synthetic superdisintegrant like Sodium Starch Glycolate with different concentrations 2%, 4%, 6 by wet granulation method. The tablets were evaluated for the precompression parameters such as bulk density, compressibility, angle of repose etc and post compression parameters like hardness, weight variation, friability, disintegration time and in-vitro dissolution profiles. Tablets containing banana powder (4%) as disintegrating agent were dispersed rapidly within 15 sec and showed 92.09% drug release in 15 min. [55].

**CONCLUSION:**

Most of therapeutic intervention requires rapid therapeutic action of drugs resulting in poor compliance for conventional dosage form. Orodispersible tablet is formulated in such a way that instant drug release is achieved. Superdisintegrants play an important role in the formulation of ODTs. These disintegrants breaks the tablet matrix into small fractions. It has been studied that natural superdisintegrants has more preponderant effects on the ODT as compared to synthetic disintegrants.
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