USE OF NATURAL SUPERDISINTEGRANT IN MOUTH DISSOLVING TABLET- AN EMERGING TREND

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ABSTRACT
Oral route is the most preferred route for administration of various drugs because it is regarded as safest, most convenient and economical route. Recently researcher developed the fast disintegrating tablets with improved patient compliance and convenience. Fast disintegrating tablets are solid dosage forms which dissolve rapidly in saliva without chewing and additional water. Fast disintegrating tablets overcome the disadvantages of conventional dosage form especially dysphagia (difficulty in swallowing) in paediatric and geriatric patients. Natural materials have advantages over synthetic ones since they are chemically inert, nontoxic, less expensive, biodegradable and widely available. They can also be modified in different ways to obtain tailor-made materials for drug delivery systems and thus can compete with the available synthetic excipients. With the increasing interest in polymers of natural origin, the pharmaceutical world has compliance to use most of them in their formulations.

KEYWORDS
Mouth Dissolving Tablet, Superdisintegrants, Plantago ovata, Lepidium sativum.

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INTRODUCTION

Recent advances in novel drug delivery system (NDDS) aims to enhance safety and by the formulating a convenient dosage form for administration to achieve the better patient compliance. One such approach is formulation of orally disintegrating tablets, these are useful for pediatric, geriatric and also dysphagic patients, leading to improved patient compliance. These dosage forms dissolve or disintegrate rapidly in the oral cavity within a matter of seconds without the need of water. Tablet disintegration has been considered as the rate limiting step in faster drug release.\textsuperscript{1-4} Natural gums and mucilages have been widely explored as pharmaceutical excipients. These are widely used in the pharmaceutical industry as thickener, emulsifier, stabilizer, gelling agent, granulating agent, suspending agent, binder, film former, disintegrant and as sustained release matrix. Demand for these natural sources is increasing and new sources are being developed. Natural gums and mucilages are preferred over semi-synthetic and synthetic excipients in the field of drug delivery because they are cheap and easily available, have soothing action and nonirritant nature. Further, they are eco-friendly, capable of multitude of chemical modifications, potentially degradable and compatible due to their natural origin.\textsuperscript{5,6}

IDEAL REQUIREMENT OF MOUTH DISSOLVING TABLET

1. Does not require water to swallow and should dissolve or disintegrate in the mouth within few seconds.

2. Allow high drug loading.

3. Be compatible with taste masking and other excipients.

4. Have a pleasing mouth feel.

5. Leave minimal or no residue in the mouth after oral administration.

6. Have sufficient strength to withstand the rigors of the manufacturing process and post manufacturing handling.

7. Exhibit low sensitivity to environmental conditions such as humidity and temperature.

8. Be adaptable and amenable to existing processing and packaging machinery.

9. Allow the manufacture of tablets using conventional processing and packaging equipments at low cost.

10. Exhibit low sensitivity to environmental condition.\textsuperscript{7}

SUPERDISINTEGRANTS

Disintegrating agents are substances routinely included in the tablet formulations to aid in the breakup of the compacted mass when it is put into a fluid environment. They promote moisture penetration and dispersion of the tablet matrix. In recent years, several newer agents have been developed known as “Superdisintegrants”. These newer substances are more effective at lower concentrations with greater disintegrating efficiency and mechanical strength. On contact with water the superdisintegrants swell, hydrate, change volume or form.
and produce a disruptive change in the tablet. Effective superdisintegrants provide improved compressibility, compatibility and have no negative impact on the mechanical strength of formulations containing high-dose drugs. The natural superdisintegrants involve various natural substances like gums, mucilages, and other substances of natural origin which are more effective at lower concentrations with greater disintegrating efficiency and mechanical strength. Some natural substances like gum karaya, modified starch and agar have been used in the formulation of FDT’s. Mucilage of natural origin is preferred over semisynthetic and synthetic substances because they are comparatively cheaper, abundantly available, nonirritating and nontoxic in nature.8,9

**SELECTION CRITERIA FOR SUPERDISINTEGRANT**

Although superdisintegrants primarily affect the rate of disintegration, but when used at high levels it can also affect mouth feel, tablet hardness and friability. Hence, various ideal factors to be considered while selecting an appropriate superdisintegrants for a particular formulation should:

1. Proceed for rapid disintegration, when tablet comes in contact with saliva in the mouth/oral cavity.
2. Be compactable enough to produce less friable tablets.
3. Produce good mouth feel to the patients. Thus, small particle size is preferred to achieve patient compliance.
4. Have good flow, since it improves the flow characteristics of total blend.10-11

**MECHANISM OF ACTION OF SUPERDISINTEGRANTS**

1. **Swelling:** Perhaps the most widely accepted general mechanism of action for tablet disintegration is swelling. Tablets with high porosity show poor disintegration due to lack of adequate swelling force. On the other hand, sufficient swelling force is exerted in the tablet with low porosity. It is worthwhile to note that if the packing fraction is very high, fluid is unable to penetrate in the tablet and disintegration is again slows down.

2. **Porosity and capillary action (Wicking):** Disintegration by capillary action is always the first step. When we put the tablet into suitable aqueous medium, the medium penetrates into the tablet and replaces the air adsorbed on the particles, which weakens the intermolecular bond and breaks the tablet into fine particles. Water uptake by tablet depends upon hydrophilicity of the drug /excipient and on tableting conditions. For these types of disintegrants maintenance of porous structure and low interfacial tension towards aqueous fluid is necessary which helps in disintegration by creating a hydrophilic network around the drug particles.
3. **Due to disintegrating particle/particle repulsive forces:** Another mechanism of disintegration attempts to explain the swelling of tablet made with “non-swellable” disintegrants. Guyot-Hermann has proposed a particle repulsion theory based on the observation that nonswelling particle also cause disintegration of tablets. The electric repulsive forces between particles are the mechanism of disintegration and water is required for it. Researchers found that repulsion is secondary to wicking.

4. **Due to deformation:** During tablet compression, disintegrated particles get deformed and these deformed particles get into their normal structure when they come in contact with aqueous media or water (Fig. 2). Occasionally, the swelling capacity of starch was improved when granules were extensively deformed during compression. This increase in size of the deformed particles produces a breakup of the tablet. This may be a mechanism of starch and has only recently begun to be studied.  

**DESCRIPTION OF NATURAL SUPERDISINTEGRANTS**

*Plantago ovata* seed mucilage

Psyllium or Ispaghula is the common name used for several members of the plant genus *Plantago* whose seeds are used commercially for the production of mucilage. Mucilage of *Plantago ovata* has various characteristics like binding, disintegrating and sustaining properties. In an investigation fast disintegrating tablets of Amlodipine Besylate was prepared by direct compression method using different concentrations of plantago ovata mucilage as a natural superdisintegrant. All formulations were evaluated for weight variation, hardness, friability, disintegration time, drug content and dissolution. The optimized formulation shows less in vitro disintegration time 11.69 seconds with rapid in vitro
dissolution within 16 minutes. *In-vitro* disintegration time decreases with increase in concentration of natural superdisintegrant.\textsuperscript{14-15}

![Image](image.png)

**Figure 2. Mechanism of Superdisintigrant- Deformation & Repulsion**

**Lepidium sativum mucilage**

*Lepidium sativum* (family: Cruciferae) is known as Asaliyo and is widely used as herbal medicine in India. It is widely available in market and has very low cost. Parts used are leaves, root, oil, seeds etc. Seeds contain higher amount of mucilage, dimeric imidazole alkaloids lepidine B, C, D, E and F and two new monomeric imidazole alkaloids semilepidinoside A and B. Mucilage of *Lepidium sativum* has various characteristic like binding, disintegrating, gelling etc.\textsuperscript{16}

**Gum Karaya**

Gum Karaya is a vegetable gum produced as an exudate by trees of the genus *Sterculia*. Chemically, Gum Karaya is an acid polysaccharide composed of the sugars galactose, rhamnose and galacturonic acid. The high viscosity nature of gum limits its uses as binder and disintegrant in the development of conventional dosage form. Karaya gum has been investigated for its potential as a tablet disintegrant. Various results showed that modified Gum Karaya produce rapid disintegration of tablets. Gum Karaya can be used as an alternative superdisintegrants to commonly available synthetic and semisynthetic superdisintegrants due to their low cost, biocompatibility as well as easily availability.\textsuperscript{17}

**Fenugreek seed mucilage**

*Trigonella Foenum-graceum* commonly known as Fenugreek, is an herbaceous plant of the Leguminous family. Fenugreek seeds contain a high percentage of mucilage (a natural gummy substance present in the coatings of many seeds). Although it does not dissolve in water, mucilage forms a viscous tacky mass when exposed to fluids. Like other mucilage-containing substances, fenugreek seeds swell up and become slick when they are exposed to fluids. Hence, the study revealed that this natural disintegrant (fenugreek mucilage) showed
better disintegrating property than the most widely used synthetic superdisintegrants like Ac-di-sol in the formulations of FDT’s. Studies indicated that the extracted mucilage is a good pharmaceutical adjuvant, specifically a disintegrating agent.\textsuperscript{18}

**Mango peel pectin**

Mango peel which constitutes 20–25% of the mango processing waste was found to be a good source for the extraction of pectin of good quality, suitable for the preparation of film and acceptable jelly. Malviya et al (2011) investigated that mango peel pectin stand as a good candidate as superdisintegrant though, not as stronger as synthetic superdisintegrant but due to its good solubility and higher swelling index, it may be used in the formulation of fast dispersible tablets.\textsuperscript{19-20}

**Agar and treated agar**

Agar is the dried gelatinous substance obtained from *Gelidium amansii* (Gelidanceae) and several other species of red algae like *Gracilaria* (Gracilariaceae) and *Pterocadia* (Gelidaceae). Agar is yellowish gray or white to nearly colorless, odorless with mucilaginous taste and is available in the form of strips, sheet flakes or coarse powder. Agar consists of two polysaccharides as agarose and agarpectin. Agarose is responsible for gel strength and Agarpectin is responsible for the viscosity of agar solutions. High gel strength of agar makes it a potential candidate as a disintegrant.

**Guar gum**

Guar gum is mainly consisting of the high molecular weight (approximately 50,000-8,000,000) polysaccharides composed of galactomannans and is obtained from the endosperm of the seed of the guar plant, *Cyamopsis tetragonaloba* (L) Taub. (syn. *Cyamopsis psoraloides*). It is used as thickener, stabilizer and emulsifier, and approved in most areas of the world (e.g. EU, USA, Japan, and Australia. It is naturally occurring gum (marketed under the trade name jaguar). It is free flowing, completely soluble, neutral polymer composed of sugar units and is approved for use in food. It is not sensitive to pH, moisture contents or solubility of the tablet matrix. It is not always pure white and sometimes varies in color from off-white to tan tends to discolor with time in alkaline tablets.\textsuperscript{21}

**Gellan gum**

Gellan gum is a water-soluble polysaccharide produced by *Pseudomonas elodea*, a bacterium. Gellan gum is an anionic, high molecular weight, deacetylated exocellular polysaccharide gum produced as a fermentation product by a pure culture of *Pseudomonas elodea*, with a tetrasaccharide repeating unit of one α-L-rhamnose, one β-D-glucuronic acid and two β-D-glucose residues. Antony et al 1997 studied the Gellan gum as a disintegrant and the efficiency of gum was compared with other conventional disintegrants such as dried corn starch, explotab, avicel (pH 10.2), Ac-di-sol. and Kollidon CL. The disintegration of tablet might be due to the instantaneous swelling characteristics of gellan gum when it comes into contact with water and owing to its high hydrophilic nature. The complete disintegration of tablet was has proved itself as superior disintegrant.\textsuperscript{22}
Soy polysaccharide

It is a natural superdisintegrant that does not contain any starch or sugar so can be used in nutritional products. Khalidindi et al 1982 evaluated soy polysaccharide (a group of high molecular weight polysaccharides obtained from soy beans) as a disintegrant in tablets made by direct compression using lactose and dicalcium phosphate dihydrate as fillers. A cross-linked sodium carboxy-methyl cellulose and corn starch were used as control disintegrants. Soy polysaccharide performs well as a disintegrating agent in direct compression formulations with results paralleling those of cross-linked CMC.

Chitin and chitosan

Chitin (β-(1→4)-N-acetyl-D-glucosamine) is a natural polysaccharide obtained from crab and shrimp shells. It possesses amino group covalently linked to acetyl group as compared to free amino group in chitosan. Chitosan is produced commercially by deacetylation of chitin, which is the structural element in the exoskeleton of crustaceans (such as crabs and shrimp) and cell walls of fungi. Bruscato et al 1978 reported that when chitin was included in the conventional tablets, the tablets disintegrated with in 5 and 10 minutes irrespective of solubility of the drug. The disintegration time in the oral cavity as well as wetting time could be analyzed by surface free energy. Chitosan is the best known natural polysaccharide used for its versatile applications in pharmaceutical industry.

CONCLUSION

In the present study the disintegrating properties of the Seed Powder, Husk Powder and mucilage powder of Plantago ovata, Lepidium sativum, Gum Karaya, Guar Gum, Fenugreek seed, Mango peel pectin etc. had been studied in comparison to artificial super disintegrants. Thus natural superdisintegrants exhibits faster drug dissolution and improved bioavailability, thereby helping in effective therapy and improved patient compliance. Thus the natural superdisintegrant can be effectively used as disintegrants in tablet formulations.

REFERENCES


