CODEN (USA): IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

Available online at: http://www.iajps.com Review Article

EMERGENCE OF NATURAL SUPERDISINTEGRANTS IN THE DEVELOPMENT OF ORALLY DISINTEGRATING TABLETS

Rakesh Pahwa*[1], Shwetakshi Sharma[1], Abhinav Singh Rana[1], Anshul Garg [1] and Inderbir Singh[2]

[1]Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra - 136119
[2] Chitkara College of Pharmacy, Chitkara University, Rajpura - 140401

Abstract:
Orally disintegrating tablets have carved a significant role amongst the oral drug delivery systems owing to their enhanced patient compliance especially in the geriatrics and pediatrics. These tablets offer numerous substantial advantages over conventional dosage forms because of improved efficacy, bioavailability and rapid onset of action. Use of natural superdisintegrants in the development of orally disintegrating tablets has numerous benefits such as chemically inert, non-toxic, less expensive, biodegradable and widely available. The present manuscript is an earnest attempt to illustrate ideal properties, significance and formulation aspect of orally disintegrating tablets especially the use of superdisintegrants. Various natural superdisintegrants utilized in the development of orally disintegrating tablets have also been discussed.

Keywords: *Orally disintegrating tablets, Natural superdisintegrants, Gums, Mucilages, Disintegration time.*

Corresponding author:
Rakesh Pahwa,
Institute of Pharmaceutical Sciences,
Kurukshetra University, Kurukshetra – 136119,
Haryana, INDIA.

QR code

Please cite this article in press as Rakesh Pahwa et al, ***Emergence of Natural Superdisintegrants in the Development of Orally Disintegrating Tablets*** *, Indo Am. J. Pharm. Sci, 2016; 3(8).*

INTRODUCTION:

A vast majority of pharmaceutical research is directed at developing new dosage forms. Most of these efforts have focused on either formulating novel drug delivery systems or increasing the patient acceptance [1]. The most popular solid dosage forms include tablets and capsules. Tablets that can rapidly dissolve or disintegrate in the oral cavity have attracted immense concern of scientific community globally. Orally disintegrating tablets are fast emerging and highly accepted dosage forms with better patient compliance. These are not only indicated for people who have swallowing difficulties, but also ideal for active people [2]. Orally disintegrating tablets are also known as quick disintegrating tablets, fast disintegrating, mouth dissolving, rapid melt, rapid dissolving or orodispersible tablets. These are novel types of tablets that disintegrate/dissolve/ disperse in saliva [3, 4].

These are solid unit dosage forms/entities containing medicinal substances which disintegrate or dissolve rapidly in oral cavity usually within a few seconds even without the need of water [5]. In such cases, bioavailability of drug is significantly enhanced by avoiding first pass hepatic metabolism than those observed with conventional tablets. Orally disintegrating tablets also combine the advantages of both liquid and conventional tablet formulations allowing the ease of swallowing in the form of liquid. The advantages of these dosage forms are continuously and increasingly being identified in both pharmaceutical industries as well as in academia [6]. The objective of present manuscript is to highlight the significance of orally disintegrating tablets, ideal characteristics, various aspects related to formulation of orally disintegrating tablets along with the potential of natural superdisintegrants.

Ideal properties of orally disintegrating tablets:

An ideal orally disintegrating tablet should meet the following criteria:

- No requirement of water for swallowing, but it should dissolve or disintegrate in the mouth usually within fraction of seconds.
- Being a unit dosage form, it should provide accurate dosing.
- Provide pleasant feeling in the mouth.
- Quick dissolution and absorption in the oral cavity.
- Leave negligible or no residue in the mouth after oral administration.
- Easy to convey.
- Manufactured by conventional processing equipments at nominal expense.
- Exhibits low sensitivity to altered environmental conditions such as humidity and temperature [3, 6, 7].

Significance of orally disintegrating tablets:

Various advantages of orally disintegrating tablets are mentioned in the subsequent section:

- Ease of administration for patients who have difficulty in swallowing, especially for geriatrics, pediatrics, mentally disabled and bed-ridden patients.
- Valuable in cases such as motion sickness, episodes of allergic attack or coughing, where an ultra rapid onset of action is required.
- An increased bioavailability due to rapid disintegration and dissolution of these tablets, predominantly in cases of insoluble and hydrophobic drugs.
- Rapid onset of therapeutic action as tablet gets disintegrated rapidly along with quick dissolution and absorption in oral cavity.
- Being unit solid dosage forms, they provide luxury of accurate dosing, easy portability and manufacturing, good physical and chemical stability and an ideal alternative for pediatric and geriatric patients.
- Stability for longer duration of time, since the drug remains in solid dosage form till it is consumed. Therefore, it combines the advantage of both solid dosage form in terms of stability and liquid dosage form in terms of bioavailability.
- Pregastric absorption can also result in improved bioavailability and because of reduced dosage, improvement in the clinical performance through reduction of adverse effects.
- Good mouth feels, especially for pediatric patients as taste-masking technique is utilized to avoid the bitter taste of drugs.
- Minimum risk of suffocation in airways due to physical obstruction, when tablets are swallowed, thus providing improved safety and compliance.
- Rapid drug therapy intervention is possible.
- Conventional processing and packaging equipments allow the manufacturing of tablets at minimal cost.
- No specific packaging is required. It can be packaged in push through blisters.
- Provide new business opportunities in the form of product differentiation, patent-life extension, individuality, line extension, life cycle management and product promotion [3, 6, 8, 9].

Superdisintegrants in the development of orally disintegrating tablets:

Disintegrants are substances or mixture of

substances added to the drug formulations, which facilitate dispersion or breakup of tablets and contents of capsules into smaller particles for quick dissolution [10]. Superdisintegrants are those substances, which facilitate the faster disintegration with lesser quantity as compared to disintegrants [11]. Superdisintegrants provide quick disintegration due to combined effect of swelling and water absorption by the formulation. Due to swelling of superdisintegrants, the wetted surface of the carrier increases, promoting the wettability and dispersibility of the system, thus enhancing the disintegration and dissolution [12].

Various mechanisms are responsible for the breaking of tablets and bulk contents of capsules into small pieces. Mechanisms of action include swelling method, capillary mechanism (wicking mechanism), combination action (both wicking and swelling action) and deformation [3, 10].

Superdisintegrants are classified into synthetic superdisintegrants and natural superdisintegrants**.** Synthetic superdisintegrants are used in tablet formulations to improve the rate and extent of tablet disintegration thereby increasing the rate of drug dissolution. e.g. sodium starch glycolate, cross-linked poly-vinyl pyrrolidone (Crospovidone), modified cellulose (croscarmelose sodium, Ac-Di-Sol), etc. Natural superdisintegrating agents which are natural in origin and preferred over synthetic substances as they are comparatively cheaper, abundantly available, non-irritating and non-toxic in nature such as *Plantago ovata*, Guar gum, *Lepidium sativum*, *Cassia fistula*, etc [13].

Natural superdisintegrants are safer as compared to synthetic superdisintegrant. They are facilely available in natural regions around the world therefore they are preferred over synthetic superdisintegrants. These are utilized in most of the preparations and more favorable over synthetic superdisintegrants as they are economical and facilely available in the sufficient quantity [14]. Various gums and mucilages from different plant species have been widely utilized as superdisintegrants due to their ability to absorb water and swelling attributes. They can swell up to 5 times their original volume and this swelling leads to breakage of tablets into smaller pieces, which in turn improves the dissolution rate [15]. Various natural plant based excipients include the following excellent characteristics such as biodegradable, biocompatible, non-toxic, low cost, environmental-friendly processing and local availability. Moreover, there are less chances of undesirable effects with natural materials as compared to synthetic ones which depict patient tolerance as well as public acceptance [16].

NATURAL SUPERDISINTEGRANTS UTILIZED IN ORALLY DISINTEGRATING TABLETS:

Various natural superdisintegrants in the development of orally disintegrating tablets have been explored by scientific community globally. These are discussed in the following section:

Plantago ovata

Polysaccharides derived from the husk of *Plantago ovata* (Family: Plantaginaceae) has been categorized as superdisintegrant. Psyllium husk contains high proportion of hemicellulose, composed of a xylan backbone linked with arabinose, rhamnose and galacturonic acid units (arabinoxylans). The *Plantago* seed consists of 35% soluble and 65% insoluble polysaccharides (cellulose, hemicellulose and lignin). Mucilage of *Plantago ovata* has high swelling index along with various characteristics like binding, disintegrating and sustaining properties. [2, 17]. Ghenge G *et al* prepared fast disintegrating tablets of amlodipine besylate using different concentrations of *Plantago ovata* mucilage as a natural superdisintegrant and concluded that the dried isabgol mucilage as a superdisintegrant in the tablet is suitable for the formulation of fast disintegrating tablets [17]. Shirsand SB *et al* studied the disintegrant property of *Plantago ovata* mucilage in comparison with crospovidone in the design of fast disintegrating tablets of prochlorperazine maleate. Experimental data revealed that results obtained from the *Plantago ovata* mucilage were comparable and even slightly better than those of crospovidone [18]. Rao NGR *et al* also formulated and evaluated fast dissolving tablets of carbamazepine using natural superdisintegrant *Plantago ovata* seed powder and mucilage. It was concluded that fast dissolving tablets of poorly soluble drug, carbamazepine will lead to increased bioavailability, improved effectiveness and hence better patient compliance by using natural superdisintegrant like *Plantago ovata* mucilage [19]. Subhashini R *et al* also formulated and evaluated domperidone fast dissolving tablets by using *Plantago ovata* mucilage as a natural superdisintegrant [20]. Pahwa R *et al* formulated and evaluated orally disintegrating tablets and compared the disintegration efficiency of mucilage isolated from natural source, *Plantago ovata* with synthetic superdisintegrant, sodium starch glycolate in the formulation of orally disintegrating tablets. Study revealed that mucilage of *Plantago ovata* proved to be more effective for their disintegrating property than the most commonly used synthetic superdisintegrant [21]. Sai Kishore V *et al* developed orodispersible tablets of sotalol hydrochloride, using different concentrations of natural superdisintegrating agents like *Plantago ovata* mucilage, synthetic and semi synthetic superdisintegrants like cross povidone and croscarmellose sodium by direct

compression method. Among all the formulations, formulation containing 5% w/w of natural superdisintegrant (*Plantago ovata* mucilage) was found to be shown faster and high drug dissolution [22].

Cassia fistula

Gum obtained from the seeds of *Cassia fistula* comprises β- (1→4) linked d-mannopyranose units with random distribution of α-(1→6) linked d-galactopyranose units as side chain having mannose: galactose (ratio 3:0). Carboxymethylation as well as carbamoylethylation of *Cassia* gum have been reported to improve cold water solubility, improve viscosity and increase microbial resistance as compared to native gum. In Ayurvedic medicine, this plant is used as a treatment for hematemesis, pruritis, leucoderma and diabetes [23, 24]. Wide range of their bio-compatibility with several drugs and other materials make them important to be used as pharmaceutical excipients [25]. *Cassia fistula* Linn. plant belongs to family Fabaceae (Caesalpiniaceae) [26]. Rai PR *et al* studied superdisintegrating properties of calcium cross-linked *Cassia fistula* gum derivatives for fast dissolving tablets. Findings indicated great potential for using calcium salts of carboxymethylated or carbamoylethylated derivatives of *Cassia fistula* as superdisintegrants in fast disintegrating tablets with high mechanical strength and low disintegration time [27].

Hibiscus rosa sinensis

Hibiscus rosa sinensis Linn commonly known as China rose, belonging to the family Malvaceae is a potent medicinal plant [28]. The organic soluble plant parts exhibits several characteristics such as anti-inflammatory, analgesic, antiestrogenic, antipyretic, antispasmodic, antiviral, antifungal, antibacterial, hypoglycaemic, spasmolytic, central nervous system depressant and many more However, the water soluble polymer is left unused and essentially goes to waste [29]. The leaves are used in traditional medicines as emollients and aperients to treat burning sensations, skin disease, and constipation [30]. Mucilage of *Hibiscus rosa sinensis* contains L-rhamnose, D-galactose, D-galactouronic acid and D-glucuronic acid [31]. Kalyani V *et al* designed and developed olanzapine immediate release tablets by using natural superdisintegrant. *Hibiscus rosa sinensis* mucilage and modified gum karaya were investigated. It was observed that formulated tablets had better drug release properties [32]. Halakatti PK *et al* formulated and evaluated mouth disintegrating tablets of famotidine by using *Hibiscus rosa sinensis* 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 [33].

Locust bean gum

Locust bean gum (also known as Carob bean gum) is derived from the seeds of the leguminous plant *Ceratonia siliqua* Linn. Gum consists mainly of a neutral galactomannan polymer made up of 1, 4-linked D-mannopyranosyl units and every fourth or fifth chain unit is substituted on C6 with a D-galactopyranosyl unit. The ratio of D-galactose to D-mannose differs and this is believed to be due to the varying origin of the gum materials and growth conditions of the plant during production. It is a neutral polymer and its viscosity and solubility are therefore less affected by pH changes within the range of 3-11 [34]. The physico-chemical properties of galactomannan are strongly influenced by the galactose content and the distribution of the galactose units along the main chain. Longer galactose side chains produce a stronger synergistic interaction with other polymers and greater functionality [35]. Locust bean gum is a versatile biopolymer which finds its various applications in different fields. The conventional use of locust bean gum as an excipient in drug products generally depends on the thickening, gel forming and stabilizing properties [36]. Malik K *et al* formulated nimesulide orodispersible tablets using locust bean gum as natural superdisintegrant. They also evaluated against standard superdisintegrant i.e. cross-carmellose sodium. It was observed that the tablets disintegrated much faster and consistently when locust bean gum was used as superdisintegrant as compared to croscarmellose sodium [37].

Chitin and Chitosan

Chitin is a natural polysaccharide synthesized by an enormous number of living organisms. When the degree of deacetylation of chitin reaches about 50%, it becomes soluble in aqueous acidic media and is called chitosan [38]. Chitosan has been investigated as an excipient in the pharmaceutical industry to be used in direct tablet compression, as a tablet disintegrant, for the production of controlled release solid dosage forms or for the improvement of drug dissolution [39]. Due to its polymeric nature, chitosan has been widely investigated for a variety of microparticulate pharmaceutical forms. Chitosan is also a candidate for potential applications in the delivery of radiopharmaceuticals, genes and peptides [40]. Goel H *et al* fabricated and optimized fast disintegrating tablets employing interpolymeric chitosan-alginate complex and chitin as novel superdisintegrants. Results suggested that excipient system under investigation not only improved the disintegration time but also made it

possible to prepare fast dissolving tablets with higher crushing strength [41]. Nagar M *et al* developed cinnarizine orodispersible tablets using chitosan as natural superdisintegrant. Developed cinnarizine orodispersible tablets improved disintegration and dissolution of the drug in oral cavity and subsequently better patient compliance along with effective therapy [42].

Aloe vera

Aloe vera has been used therapeutically for many centuries and is of particular interest due to its lengthy historic reputation as a curative agent and its widespread use in supplementary therapies. Aloe gel is the colorless gel contained in the inner parts of the fresh leaves. Chemical analysis has revealed that this clear gel contains amino acids, minerals, vitamins, enzymes, proteins, polysaccharides and biological stimulators [43]. *Aloe vera* has been used for many centuries for its curative and therapeutic properties. In the pharmaceutical industry, it has been used for the manufacture of topical products such as ointments and gel preparations, as well as in the production of tablets and capsules [44]. Panigrahi R *et al* prepared fast dissolving tablets of lisinopril by direct compression method using *Aloe vera* gel, *Plantago ovata* and *Hibiscus rosa sinesis* as natural superdisintegrants. It was concluded that *in vitro* disintegration time was reduced and *in vitro* release was significantly improved [45].

Guar gum

Guar gum is a water soluble polysaccharide derived from the seeds of *Cyamopsis tetragonolobus* (family Leguminosae). It consists of linear chains of (1→4)-β-D-mannopyranosyl units with α-D-galactopyranosyl units attached by (1→6) linkages. It contains about 80% galactomannan, 12% water, 5% protein, 2% acidic insoluble ash, 0.7% ash and 0.7% fat [46, 47]. Sharma R *et al* studied the effect of starch and guar gum 4000 on disintegrating time and dissolution behavior of drug zolmitriptan from fast dissolving tablets. Tablets were prepared by direct compression method. Studies revealed that when guar gum (5%) and starch (10%) were used in formulation, the plasma concentration of drug was increased because it disintegrate tablet rapidly and drug was released rapidly from dosage form [48].

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 findings show that modified Gum karaya produces rapid disintegration of tablets. Gum karaya can be used as an alternative superdisintegrants to commonly available synthetic and semi-synthetic superdisintegrants due to their low cost, biocompatibility as well as easy availability [49]. Bansal N *et al* formulated and evaluated orally disintegrating tablets of ondansetron hydrochloride using modified gum karaya and modified natural agar as natural superdisintegrants. Results showed that modified gum karaya and modified natural agar produce rapid disintegration of tablets [50].

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 colourless, odourless with mucilaginous taste and is accessible in the form of strips, sheet flakes or coarse powder. Agar consists of two polysaccharides as Agarose and Agaropectin. Agarose is responsible for gel strength and Agaropectin is responsible for the viscosity of agar solutions. It is a potential candidate to act as a disintegrant due to its high gel strength. Gums are used in concentration from 1 to 10% [51]. Sharma V *et al* used modified polysaccharide prepared by employing agar as fast disintegrating excipient for orodispersible tablets of roxithromycin. Results indicated that modified polysaccharide exhibited least disintegration time. Hence, the approach of using modified polysaccharides as fast disintegrating excipient can be used to formulate a stable orodispersible formulation [52]. Peter R *et al* formulated fast dissolving tablets of flunarizine hydrochloride by sublimation method using camphor and menthol as sublimating agents and treated agar as superdisintegrant. It was concluded that formulation showed maximum drug release within 90 seconds. Fast dissolving tablets of flunarizine hydrochloride by sublimation method using menthol as sublimating agent and treated agar as superdisintegrant can be used for better patient compliance [53]. Prakash P *et al* formulated, evaluated and optimized piroxicam fast dissolving tablets using treated agar as natural disintegrant. Influence of the disintegrant concentration on the release of piroxicam was studied. *In vivo* disintegration time of tablets was found to be less than 60 sec., *in vitro* dissolution profile indicated a faster and maximum of 99.3% drug release proving the disintegrating property of treated agar gum [54].

Fenugreek seed mucilage

It is obtained from the seeds of *Tregonella foenum-graecum* Linn (family Fabaceae). Several

parts of fenugreek, mainly its leaves and seeds have been widely employed in the Indian food. It has numerous cosmetic and medicinal uses like gastroprotective, hypoglycemic, diuretic, anti-inflammatory agent and as antioxidant. Mucilage of seeds has been utilized as pharmaceutical excipients due to its non-toxicity, low cost, free availability, emollient and non irritating nature [55, 56]. Kumar R *et al* isolated and evaluated disintegrant properties of fenugreek seed mucilage. Studies revealed that fenugreek mucilage showed better disintegrating property than the most widely used synthetic superdisintegrants like Ac-di-sol in the formulation of fast disintegrating tablets [57]. Sukhavasi S *et al* formulated and evaluated fast dissolving tablets of amlodipine besylate by using fenugreek seed mucilage and *ocimum basilicum* gum as natural superdisintegrants. The tablets disintegrated much faster and consistently when fenugreek seed mucilage and *Ocimum basilicum* gum were used as superdisintegrant as compared to synthetic superdisintegrants. [58]. Kumar MU *et al* designed and evaluated fast dissolving tablets containing diclofenac sodium using fenugreek gums as natural superdisintegrant. Study revealed that the fenugreek gum as a natural superdisintegrant showed better disintegrating property than the most widely used synthetic superdisintegrants like sodium starch glycolate and croscarmellose sodium in the formulation of fast dissolving tablets [59].

Soy polysaccharide

Soy polysaccharide, which is sourced from dehulled and defatted soybean flakes, is soft white to light–tan fibrous powder and does not contain starch or sugar. It has 75% dietary fiber with the main components including five types of higher polysaccharides, viz, cellulose, hemicellulose, pectin, gum, and mucilage. Soy polysaccharide has been utilized in the dietary supplements due to high fiber content. The commercial version of the soy polysaccharide (Emcosoy®) is being employed as a super-disintegrant in compressed tablets [60]. Hosny KM *et al* prepared and evaluated simvastatin orodispersible tablets containing soy polysaccharide as a novel superdisintegrant. Orodispersible tablet showed least wetting and disintegration time, faster water absorption rate and the highest dissolution rate [61]. Gunjal S *et al* formulated, developed and evaluated amlodipine besylate orally disintegrating tablet using natural superdisintegrant, soy polysaccharide and synthetic superdisintegrant, croscarmelose sodium. They concluded that enhanced disintegration of the tablet was might be due to combined effect of swelling and wicking properties of soy polysaccharide and croscarmelose sodium [62].

Gellan gum

Gellan gum is obtained from *Pseudomonos elodea*. It is a linear anionic polysaccharide biodegradable polymer consisting of a linear tetrasaccharide repeat structure and is used as a food additive. Gellan gum is used as a superdisintegrant and 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 [63, 64]. Shah DP *et al* employed a newer application of physically modified gellan gum in tablet formulation using factorial design. They examined the physically modified 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 [65]. Prajapati ST *et al* prepared and evaluated sublingual tablets of zolmitriptan using direct compression technique. Batches prepared with gellan gum shows minimum disintegration time [66].

***Lepidium sativum* mucilage**

Lepidium sativum (family: Cruciferae) is known as asaliyo and widely used as herbal medicine in India. It is widely available in market and has very low cost. Seeds contain higher amount of mucilage, dimeric imidazole alkaloids lepidine B, C, D, E, F and two new monomeric imidazole alkaloids semilepidinoside A and B. Mucilage of *Lepidium sativum* has various characteristics such as binding, disintegrating, gelling etc. [67]. *Lepidium sativum* is one of the mucilage containing fast growing edible annual herb [68]. Mehta KK *et al* utilized *Lepidium sativum* in the comparative evaluation of natural and synthetic superdisintegrant for promoting nimesulide dissolution for fast dissolving technology. It was concluded that higher dissolution of tablet could be obtained when mucilage concentration is 10%. It was also found that mucilage batch provides desirable fast release action as compared to synthetic superdisintegrants [69].

***Aegle marmelos* gum**

The unripe fruit of *Aegle marmelos* (commonly known as Bael) is reported to contain bioactive compounds such as carotenoids, phenolics, alkaloids, pectins, tannins, coumarins, flavonoids and terpenoids [70]. The fruit is edible and has been recommended for use as antiamoebic and antihistaminic agents [71]. The bael fruit gum (BFG) is reported to contain a high (54.26% w/w) content of D-galactose and 20.8% w/w glucouronic acid as compared to other commonly used gums. Therefore, BFG can be expected to possess better aqueous solubility and water

retaining capacities due to the presence of high D-galactose content [72]. In addition, *Aegle marmelos* fruit pectin has been used in a number of foods as a gelling agent, thickener, texturizer, emulsifier and stabilizer [73]. Kulkarni U *et al* designed and developed aceclofenac fast dissolving tablets by amorphous solid dispersion technique using modified *Aegle marmelos* gum. Results indicated that solid dispersion of aceclofenac with modified *Aegle marmelos* gum could be useful in developing fast dissolving tablets with increased solubility and hence improved dissolution as well as oral availability of poorly soluble drug [74].

Dehydrated banana powder

Dehydrated banana powder is prepared from the variety of banana called Ethan or nenthran (nenthra vazha) and belongs to the family Musaceae. It contains vitamin A, so it is utilized in the treatment of gastric ulcer and diarrhoea. 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 [75]. Taksande JB *et al* formulated and characterized fast dissolving tablets of lornoxicam using different natural and synthetic superdisintegrant by direct compression technique. The natural superdisintegrant banana powder, soy polysaccharide and synthetic superdisintegrant, crosspovidone were used. It was concluded that tablets prepared by addition of natural superdisintegrant has less disintegration time, more water absorption and drug release [76]. Bharathi A *et al* evaluated natural superdisintegrant banana powder in the orally disintegrating tablets using telmisartan as model drug. They compared it with other synthetic superdisintegrants in the preparation of orally disintegrating tablets. It was concluded that banana powder had excellent superdisintegrant property which can be very well utilized for developing orally disintegrating tablets. Tablets containing banana powder as disintegrating agent were dispersed rapidly within 15 sec and showed 92.09% drug release in 15 min. [77].

Cassia tora

Cassia tora gum derived from the seeds of *Cassia tora* Linn. is a common herbaceous annual occurring weed throughout India [78]. *Cassia tora*, a popular Indian medicinal plant has long been used in ayurvedic system of medicine. The plant has been found to possess diverse number of pharmacological activities like laxative, skin diseases, eye diseases, liver complaint, dysentery and antihelmenthic. Various other activities such as antioxidant, hypoglycemic, hypolipidemic, antifungal, antiplasmodic, antimicrobial, hyperlipemia and hypotensive have also been reported [79]. Pawar H *et al* developed and evaluated orodispersible tablets using natural polysaccharide isolated from *Cassia tora* seeds. Report revealed that *Cassia tora* seed polysaccharide has a good potential as a disintegrant in the formulation of orodispersible tablets [80]. Garg V *et al* prepared fast disintegrating tablets of glibenclamide to improve patient compliance. Fast disintegrating tablets were prepared using natural superdisintegrant *Cassia tora* and *Plantago ovata* by direct compression method. They concluded that the fast dissolving drug delivery system of glibenclamide can be successfully formulated [81].

Ocimum basilicum

Ocimum basilicum or sweet basil, a culinary herb. *Ocimum basilicum* is a common ingredient in Thai cuisine, with a strong flavour similar to aniseed, used to flavour curries and stir fries. It has been used as a folk remedy for an enormous number of ailments including boredom, convulsions, deafness, diarrhea, epilepsy, gout, hiccup, impotency, insanity, nausea, sore throat, toothaches and whooping cough [82]. *Ocimum basilicum* is a rich source of anthocyanins and an abundant source of acylated and glycosylated anthocyanins. Aroma compounds are also extracted from *O. basilicum* and used in a wide variety of products such as cosmetics and natural flavors [83]. Sharma A *et al* studied the effect of mucilage of *Ocimum basilicum* on formulation of rapid disintegrating tablets of lamotrigine and compared it with different novel synthetic superdisintegrants. *Ocimum basilicum* seeds mucilage was also characterized on the basis of its organoleptic properties, micromeritic properties along with melting point and solubility determination. They revealed that it would be possible to get the rapid onset of action of the anti-epileptic drug lamotrigine and thus can control the serious epileptic convulsions in the minimum time [84]. Hardikar S *et al* developed fast disintegrating tablets of paracetamol by employing the dried mucilage isolated from the seeds of *Ocimum basilicum*. Fast disintegrating formulations were prepared by using established disintegrants and dried mucilage as novel disintegrating agent. Tablets prepared by using dried mucilage as disintegrating agent resulted in rapid disintegration of the tablet comparable to established disintegrants [85]. Panda BP *et al* optimized diclofenac sodium orodispersible tablets with natural disintegrants seed mucilage of *Plantago ovata* and seed mucilage of *Ocimum basilicum* using response surface methodology. Optimization studies by multiple regression analysis revealed that 6% of *Plantago ovata* and 5% of *Ocimum basilicum* was found to be

optimum which has disintegration in 36 sec and cumulative drug release was 99.2% at 25 min [86].

Several scientific advancements utilizing natural superdisintegrants in the development of orally disintegrating tablets have been carried out worldwide which reflect their successful and effective applications in drug delivery. Moreover, natural superdisintegrants provides exciting opportunities in the fascinating arena of herbal technology and various drug delivery approaches. In addition, it is also evident that natural superdisintegrants are preferred over synthetic superdisintegrants as they are non-toxic, easily available at low cost, used in low concentration and are naturally extracted.

CONCLUSION:

Orally disintegrating tablets offer numerous significant advantages over conventional dosage forms because of improved efficacy, enhanced bioavailability, rapid onset of action along with better patient compliance and acceptance. Use of natural superdisintegrants has considerable outcome in the design of orally disintegrating tablets as compared to synthetic superdisintegrants. Natural superdisintegrants incremented the drug release rate from the tablet and decremented the dissolution and disintegration time. Natural superdisintegrants are preferred over synthetic ones as they are non-toxic, facilely available at low cost, utilized in low concentration and are naturally extracted. Natural superdisintegrants exhibit faster drug dissolution and increased bioavailability, thereby, resulting in efficacious therapy and improved patient compliance.

ACKNOWLEDGEMENT:

We express sincere thanks to Prof. A. C. Rana, Dean and Director, Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra, for providing necessary facilities.

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