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REVIEW ARTICLE

Various Patents on Different Types of Tablets: A Review

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Abstract
The oral route is considered as the most promising route of drug delivery of various drugs because it regarded as safest and most convenient route. Tablets and capsules are most popular drug delivery systems administered via oral route. The basic advantage of tablet over capsule is that tablets have more physical and chemical stability over capsule. A tablet is compressed solid unit dosage form containing medicament with or without excipients. They are different in shape, size and weight depending upon the dose & content of drug. In recent year, scientific advancement has been made in the research and development of this type of dosage form. In this review article, we will discuss about various types of tablet &patents. Pharmaceutical oral solid dosages forms have been widely used for decades mainly due to their suitability for delivery and delivery of drug for systemic effect.

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INTRODUCTION

Oral route is the most common route for administration of various drugs because it is regarded as safest, most convenient and economical route. Tablets and capsules are most popular drug delivery systems. A tablet is compressed solid unit dosage form containing medicament with or without excipients. They are different in shape, size and weight depending upon the content of drug and mode of administration.[1] They offer safest and convenient ways of administration for active pharmaceutical ingredients (API) with excellent physicochemical stability in comparison to other dosage forms. They also provide means of accurate dosing.[2] However, many patient groups such as the elderly, children and patients who are mentally retarded, un-co-operative, and nauseous or on reduced liquid-intake/diets have difficulties in swallowing these dosage forms. To overcome these problems, scientists go through various innovative developments such as formulation of orodispersible tablet which can dissolve/ disintegrate/ disperse in saliva within few seconds without water.

ADVANTAGES OF TABLETS

1. They are unit dosage form and offer the greatest capabilities of all oral dosage form for the greatest dose precision and the least content variability.
2. Tablets are less expensive compare to other oral dosage form.
3. They are easy to administer.
4. Sustained release action can be achieved.
5. Objectionable odour and bitter taste can be masked.
6. These are suitable for large scale production.
7. Greatest chemical and microbial stability over all other dosage form.
8. Product identification is easy and rapid, requiring no additional steps when employing an embossed and/or monogrammed punch face.[3]

DIFFERENT TYPES OF TABLETS

Tablet can be classified according to their mode of administration and function into the following types:[3] (Fig 1).

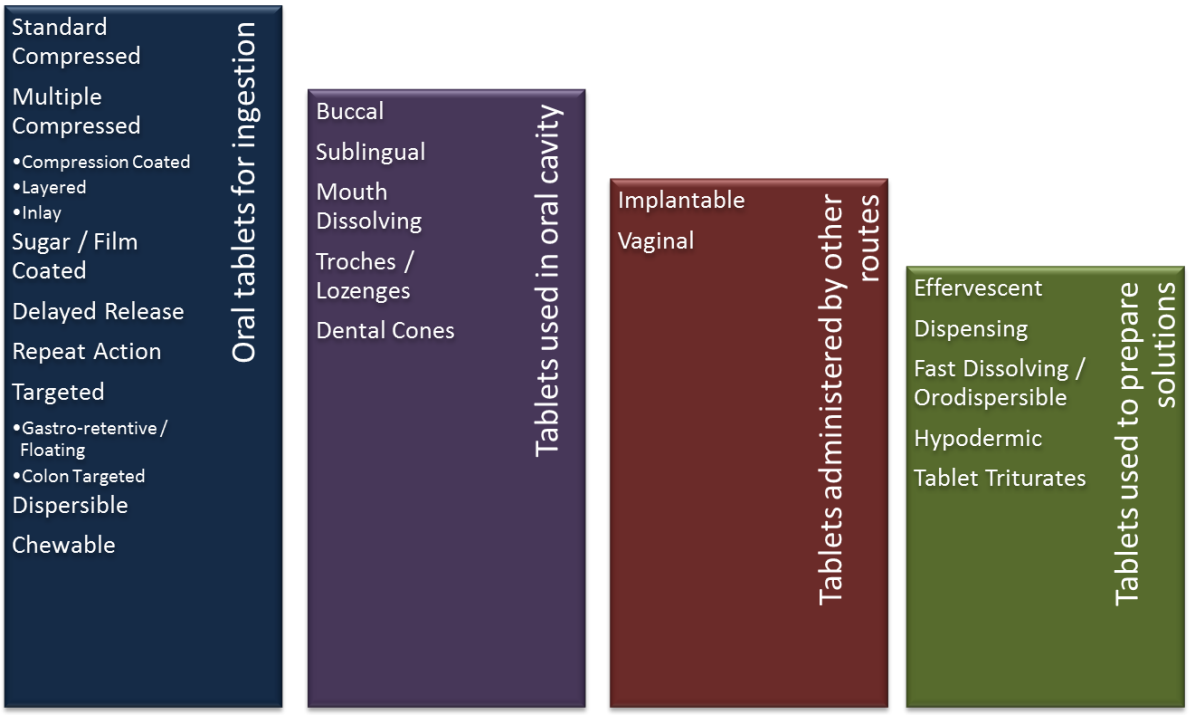

Fig 1. Different types of tablets

Compressed Tablets

Standard uncoated tablets are manufactured by compression. The general methods as - wet granulation, dry granulation or direct compression, are used. These types of tablet produce both type of action, i.e. systemic effect and local effect. Various patents on compressed tablets include the following:

1. Leal (1962) worked on "method of making a compressed tablet". This invention involves a new process of forming firm, smooth, and pharmaceutically elegant compressed tablets from particulate tableting compositions devoid of a tablet die lubricant.[4]
2. Stearns (1960) worked on "use of Calcium Silicate in tablet compressing". In this invention, it is found that the addition of about 20% w/w of calcium silicate aerogel to crystalline or powdered blend so that it become capable to directly compressed into suitable tablets form on automatic tablet punching machine. Lubricants such as magnesium stearate, fillers such as starch, or disintegrate or such as polyvinyl pyrrolidone may be added to the mixture of the calcium silicate aerogel and the crystalline or powdered material prior to tableting on automatic tablet punching machine. This invention completely eliminates the necessity of first preparing a granulation of crystalline or powdered materials before compressing them into tablets.[5]
3. Creevy (1948) worked on "manufacture of the Compressed Tablets". The main aim of the invention is to overcome the difficulties and provide an improved means for manufacture of compressed tablet. By constructing the wall of the compression chamber in a tableting machine of a suitable porous metal and supplying a liquid lubricant. Under pressure to said porous metal a 'film of lubricant can readily be formed on the inner wall; of the compression chamber, thus enabling materials which normally tend to bind in the die and to be injectable therefrom.[6]
4. Whyte (1902) worked on Compressed Tablets in which, it is found that if the dry potassium carbonate and ferrous sulfate mixed and compressed into a tablet there will be a reaction soon resulting in the product of ferric carbonate and consequent deterioration of the tablet. On the other hand, by compressing these reagents together in layers, the reaction can only take place along the surface of contact, and have found that the extent of the reaction is so small as not to materially impair the value of the tablet.[7]

Multiple Compressed Tablets

These types of tablets are generally use for incompatible components and/ or to produce repeat action or prolong action.

a. Layered tablets: This type of tablets contains either two layers (for two components) or three layers (for three components).
b. Compression coated: This type of tablets contains either tablet within a tablet or tablet within a tablet within a tablet.

Various patents on multi-compressed tablets:

1. Thoen (2003) worked on "multi-layer detergent tablet having both compressed and non-compressed portion". He prepared a detergent tablet comprising of:
   - A compressed solid body portion having therein at least one mould in said compressed solid body portion. Surface area of said detergent tablet, excluding area of said at least one mould is A.
   - At least one non-compressed, non-encapsulating portion mounted in said at least one mould of said compressed solid body portion, having an area of B comprising at least one detergent active.
   - Wherein further ratio of B to A is from about 1:50 to about 4:1, by area.[8]
2. Andoh *et al* (1996) worked on "sustained-release multi-granule tablet." In his invention a sustained-release multi-granule tablet was prepared by compressing sustained-release granules, which contains an active substance, and a formulation adjuvant. Each of the granules has been coated with a layer of the formulation adjuvant and/or a layer of a mixture of the formulation adjuvant and the active substance. They found that the tablet releases an active substance at a suitable velocity into the digestion tract, resulting in that the variability in the absorption of the drug and maximum bioavailability may achieved.[9]

3. Beringer (1979) worked on "process for the manufacture of a multi-zone tablet and tablet manufactured by this process." The multi zone-pharmaceutical tablets are prepared by compressing the contents of a tablet mold. The contents include a granular chewing gum mass and a non-plastic tablet mass, or a chewing gum insert in the recess of a multilayer non-plastic tablet mass. One zone of the tablet, preferably the chewing gum mass, contains a pharmaceutically active ingredients.[10]

Repeat Action Tablets

Generally the Sugar coated or multiple compressed tablets are used for this purpose. In this typethe core tablet is usually coated with shellac or an enteric polymer so that it will not release its drug in stomach. The basic principle in the preparation of Repeat action tablets is that an initial dose of drugs is released immediately and a second dose followslater.[11]upon administration, the outer tablet provides a controlled release of the active ingredient while the inner tablet gives a second dose of active ingredient after the outer tablet has partially dissolved. The repeat-action tablet is especially efficacious for those active ingredients which have half-lives of less than two hours and which experience decreased absorption efficiency inthe lower gastrointestinal tract.

Dansereau *et al* (1991) have patented a work on "dual-action tablet". In his invention, the purpose of making dual action table have a particular benefit for those active ingredients which have half-lives of less than two hours and for those which have narrow window of absorption. The meaning of dual action here is one is control release effect and another is bursting effect.

- An outer tablet comprising of a pH independent hydrophilic polymer matrix that impart a control release effect.
- An inner tablet core comprising of a rapidly disintegrating excipient base that impart a bursting effect.

Both inner and outer tablet contained active ingredients.[12]

Delayed Action, Sugar / Film-coated and Enteric-coated Tablets

This type of tablet is intended to release the drug after some time delay or after the tablet has passed one part of the GIT into another.

Film-coated Tablets

Film coated tablets are compressed tablets coated with a thin layer of a polymer capable of forming a skin like film. The film is usually colored and has several advantages over sugar coating, as it is more durable, less bulky and less time consuming to apply. Film coating solutions may be non-aqueous or aqueous.[13]

Enteric-coated Tablets

Enteric coated tablets are solid unit dosage forms which are designed to bypass the stomach and release the drug in small intestine. The word "enteric" means small intestine; therefore enteric coatings on a tablet prevent release of medication before it reaches the small intestine. Most enteric coatings work by presenting a coated surface that is stable at the highly acidic pH found in the stomach, but breaks down rapidly at a less acidic (relatively more basic) pH.[14] All enteric coated tablets are delayed action tablet but all delayed action tablets are not enteric or not intended to produce enteric action.

Various patents on film-coated tablets:

1. Flanagan *et al* (2003) have patented a work on "Gellan gum tablet film coating", in which, the tablet is film coated with Gellan gum coating composition containing Gellan gum, a plasticizer, and a disintegration aid. Optionally a slip enhancer is added to the composition. A method for coating a tablet with the Gellan gum composition wherein the composition is applied as a solution. He use Gellan gum in film coated tablet because it have higher gloss, better mouth feel, non-tackiness, better taste, being swallow able with little or no accompanying liquid and easier to swallow than commercially available forms.[15]
2. Joseph (1998) has patented "Enteric coated tablet with raised identification character and method of manufacture." A mechanical configuration for a tablet, and a method for manufacturing the same, which allows an enteric coating to be applied to an embossed bio-compatible tablet, for

identification purposes. The enteric coating remains uniform over the entire tablet allowing for release of the drug as designed.[16]

3. Gilis *et al* (1997) have worked on "extended release film-coated tablet of Astemizole and Pseudoephedrine." Film coated tablets comprising as active ingredients of the antihistaminic. Anti-allergic agent Astemizole and the Adrenergic, Decongestant agent (Pseudoephedrine hydrochloride) and a process of preparing such tablets. Hydrophilic polymer is used as extended release film used to coat the tablet thus having maximum plasma concentration.[17]
4. McCabe *et al* (1992) have patented a "flavored film-coated tablet". The invention comprises a flavored thin film coating on solid oral dosage pharmaceutical tablets containing unpleasant tasting ingredients such as triprolidine hydrochloride and pseudoephedrine hydrochloride. The flavored coating of the invention is comprised of a film forming substance such as a hydroxyl propyl methylcellulose and a polyethylene glycol as a sweetening agent and a flavoring agent. The method of the invention comprises aqueous spray-coating of the flavored sweetened coating onto the pharmaceutical tablets[18].
5. Luber (1979) has patented a "film coated tablet composition having enhanced disintegration characteristics." It comprises a hydrophilic film forming polymer such as hydroxyl propyl methylcellulose and an alkaline agent wherein the alkaline agent reduces the disintegration time of the film coating by increasing the rate of removal of the film coating polymers[19].

Sugar Coated Tablets

Primary role is to produce an elegant, glossy, easy to swallow, widely utilized in formulation of multivitamin and multivitamin mineral combination. Sugar coating doubled the tablet weight. Now polymers are used with sugar solution.

Various patents on Sugar coated tablets:

1. Becker (1973) worked on "method of sugar-coating tablets." In this invention, tablets were sugar-coated with an aqueous sugar-coating solution which comprises about 5 Percent to 30 percent by weight of calcium sulfate di-hydrate. The coating solution was adaptable to automatic application, which greatly reduced the time normally required for sugar coating tablets. The tablets obtained by this method have good elastic and mechanical strength.[20]
2. Kawata *et al* (1972) worked on "method of sugar coating tablets." Tablet cores containing medicaments, particularly, hygroscopic medicaments are coated by applying directly to sugar syrup containing sucrose, higher fatty acid ester without applying water proof coating or other sub coating treatment[21].
3. Magid *et al* (1972) worked on "silica gel stabilizer for sugar coated multivitamin tablets." The multivitamin tablets are bitter in taste thus need to sugar coated to provide more elegant and glossy effect to the tablet and easy to swallow. But the problem may occur with the oily vitamin E active compounds have a tendency to bleed out of the tablet and cause cracking of the sugar coating, particularly upon storage. The Sugar coated multivitamin tablets were prepared by direct compression containing a high potency of vitamin E. The tablet was stabilized against cracking and oil bleeding by the inclusion of finely divided silica in the sugar coating. This problem is mostly occur in multivitamin tablets prepared by direct compression and by this invention it is possible to prepare multivitamin tablets by direct compression which contain 10 to 30 units of vitamin E and which are stable against bleeding of oil and cracking of the sugar coating on storage.[22].

Chewable Tablets

These type of tablets generally used for preparation of large tablet of antacid. Bitter or foul taste drugs are not suitable candidates for this type of tablet. Chewable tablets are tablets which are required to be broken and chewed in between the teeth before ingestion. These tablets are given to the children who have difficulty in swallowing. Ideally chewable formulation should have smooth texture upon disintegration, pleasant taste or no bitter or unpleasant taste.[23]

Various patents on chewable tablets:

1. Kasrakasraian *et al* (2004) worked on "a palatable chewable tablet comprising of cetirizine or a pharmaceutically acceptable salt." Cetirizine is very bitter tasting drug and due to its bitter taste, it

needs to be made more palatable for children to encourage better compliance. The formulation is made more palatable by using a combination of grape flavoring agent and vanilla flavoring agent as a sweetener.[24]

2. Weckenmann (1997) worked on "sucralfate chewable tablet". This invention is related to pharmaceutical compositions in the form of pleasant-tasting chewable tablets or chewable coated tablets is made by using the pharmaceutically active ingredient sucralfate, essentially contain at least one rapidly swellable physiologically acceptable gel former plus sugars or sugar substitutes.[25]
3. Puglia *et al* (1982) worked on "compressed chewable antacid tablet and method for forming same." & found that an improved compressed soft chewable tablet, which may contain an antacid or other active ingredient has good flexib1ity, is breakage resistant and disintegrates immediately upon chewing.[26]
4. Gaunt *et al* (1971) worked on "pleasant tasting chewable tablets and their production". Tis invention describes the method of masking the taste of unpleasant taste or bad tasting drug without change in availability of drug in the body. In his invention he found that water-soluble bad-tasting drugs and vitamins are put into chewable tablet form wherein the drugs and vitamins have a pleasant taste and are readily available upon ingestion[27].

Buccal and Sublingual Tablets

These tablets are small, flat and are intended to be held between the cheek and teeth or in cheek pouch (buccal tablet) or below the tongue (sublingual tablet). Drugs used by this route are for quick systematic action. The tablets are designed not to be disintegrated but slowly dissolve. Various patents on buccal tablets:

1. McCarty (1992) worked on "fast dissolving buccal tablet". In this invention, he used a desirable amount of an active ingredient in combination with sorbitol used as an excipients and a lubricant. This fast dissolving buccal tablet provides extremely rapid drug delivery in an unexpected manner it means, giving a blood levels which are comparable to parenteral administration of the active ingredient.[28]
2. Sugden (1989) worked on "buccal tablet comprising atropine or a salt". His invention was based on pharmaceutical compositions in the form of a buccal tablet comprising atropine or a salt, at least one monosaccharide, disaccharide or a mixture of xanthan gum and locust bean gum in a weight ratio 3:1 to 1:1, wherein the total weight of the mono- and/or disaccharides relative to the combined weight of the xanthan and locust bean gums is in the ratio of 20:1 to 3:1. He found that the improved bioavailability of the tablet.[29]
3. Kracauer (1980) worked on "sublingual Aspirin tablet". Aspirin is the most commonly used antipyretic, analgesic, anti-inflammatory agent. The usual pain-relieving adult dosage is 300 to 600 mg. To minimize frequent Aspirin-induced gastric disturbance, many Aspirin products contain buffering agents. Only a portion of the Aspirin acts as Aspirin, as part of the Aspirin is decomposed into salicylic acid and acetic acid. Buffering agents cannot fully neutralize these acids along with the gastric acids, especially when larger Aspirin doses are required. The likelihood of GI tolerance cannot be fully improved by any buffering agent. Aspirin is effective within 15 to 25 minutes after swallowing.[30]
4. Fusari *et al* (1974) worked on "stabilized molded sublingual nitroglycerin tablets". Pharmaceutical compositions containing minor proportions of nitroglycerin and a non-volatile, water soluble solvent in combination with a major proportion of a solid, water-soluble pharmaceutical carrier. Those compositions, in the form of tablets suitable for sublingual administration, can be produced by wetting a substantially dry mixture of the nitroglycerin and the solid, water-soluble pharmaceutical carrier with a solvent mixture containing a non-volatile, water-soluble solvent and a volatile solvent, forming the wetted mixture into tablets, and removing the volatile solvent.[31]
5. Wershaw *et al* (1964) worked on "buccal tablet containing vitamin A and sodium proteinate". This invention relates to buccal tablets containing vitamin A with or without vitamin C for oral administration and found that buccal tablet containing vitamin A should have the following properties: [32]
    - It should dissolve very slowly and have effective systemic utilization of vitamin A
    - Have a pleasant taste and odour

- Chemically stable for relatively long period of time.

Effervescent Tablets

Effervescent tablets are designed to be dissolved or dispersed in water before administration. The tablet is promptly broken apart by internal release of CO_2 in water and the CO_2 reaction is created by an interaction of tartaric acid and citric acid with alkali metal carbonate or bicarbonates in presence of water.[33]

Various patents on effervescent tablets:

1. Lundberg *et al* (2001) worked on "multiple unit effervescent dosage form" and in his invention he found that an effervescent pharmaceutical preparation comprising effervescent excipients and a plurality of individual units comprising a pharmaceutically active compound and optional excipients wherein the units are having a floating generating system. The floating generating systems comprise at least two coating layers, one of which is a gas generating layer and the other layer is a barrier layer enclosing the generated gas.[34]
2. DeSenna (2000) worked on "disinfectant effervescent tablet formulation". In his invention he has made water soluble effervescent tablet for preparing a disinfecting solution comprising a first tablet containing a bromide releasing agent and a second tablet containing a hypochlorite releasing agent. The solution obtain by this invention may be used as for cleaning dental, medicinal instrument and equipment etc.[35]
3. Gergely *et al* (1999) worked on "effervescent system for effervescent tablets and effervescent granules". The effervescent system for effervescent tablets and/or effervescent granules contains, on the one hand, particles of a solid, edible, organic acid and, on the other hand, particles of at least one alkali metal bicarbonate, of which at least 1, preferably from 2 to 4, but at most 10, preferably at most 8% by weight are superficially converted into dry alkali metal carbonate free of water of crystallization. It was found that, from an effervescent tablet containing acetylsalicylic acid and untreated sodium bicarbonate, from 5 to 10% by weight of the acetylsalicylic acid had been converted into free salicylic acid after only a few hours at 45° C; with sodium bicarbonate modified according to this patent. However, the relevant figure was still more than 1, in general about 5% by weight.[36]
4. Alexander *et al* (1987) worked on "method to make effervescent calcium tablets and calcium tablets produced thereby" and found a directly compressible formulation comprise calcium carbonate, citric acid, and an impression vehicle comprises a malto-dextrin and lactose in the formulation can be compressed into an effervescent tablet system, which when placed in water, effervesces in a relatively rapid dissolution releasing CO_2 and resulting in a solution of mono-calcium citrate.[37]
5. Quinlan (1979) worked on "Levamisole effervescent tablets". In his invention he found Levamisole effervescent tablets which comprise a composition characterized by excellent solubility yielding crystal clear solutions in water, good storage stability, and ease of use. They also provide methods for, the oral administration of Levamisole to swine in predetermined dosages via the drinking water offered to say animals utilizing the aforesaid Levamisole effervescent tablets.[38]
6. Gergely (1972) worked on "method for the manufacture of effervescent tablets". In his invention he found that the method for the manufacture of effervescent tablets containing at least one medicine, on the other hand an effervescent mixture comprising the granulation of the effervescent mixture possibly containing the medicine in three stages:
   - The humidification of the effervescent mixture by means of a quantity of water less than 1% by weight with respect to the alkaline bicarbonate;
   - The pro-drying of the humidified effervescent mixture in a fluidized bed, by hot air, the moisture content of which does not exceed 5 g./m.^{3} and the temperature of which does not exceed 60° C., this operation taking place by a sequence of short drying operations so as to stop the chemical reaction; and
   - The final drying of the granulated mixture by hot air, the moisture content of which does not exceed 5 g./m.^{3}, and the temperature of which does not exceed 60° C., in a fluidized bed, until the residual content of water in the granules is less than 0.25% by weight and, preferably comprised between 0.05 and 0.15%. [39]

Dispersing Tablets

Dispersing tablets are intended to be added to a given volume of water to produce a solution of a given drug concentration.

Various patents on dispersible tablets:

1. Di Costanzo *et al* (2013) worked on "orally dispersible tablet with low friability and method for preparing same". He found that a rapidly disintegrating tablet is similar to those designed to disintegrate in the mouth on contact with saliva in less than 30 seconds, forming an easy-to-swallow suspension, and based on an active substance in the form of coated microcrystals or micro granules and a mixture of excipients including at least a disintegrating agent, a soluble agent and a lubricating agent. The invention is characterized in that the lubricating agent is in powder form and is distributed at least for the greater part on the tablet surface and its friability is less than 1%, and preferably less than 0.5 and has the required and adequate hardness to enable it to be removed with ease from the blister pack in which it is packaged, by perforating the seal thereof by pushing the tablet, with a substantially reduced risk of the tablet breaking during removal. The invention also concerns the method for producing said tablet.[40]
2. Fielden *et al* (1997) worked on "water-dispersible tablets". In this invention, a water-dispersible tablet comprises Acyclovir and a dispersing agent is described. The dispersing agent is swellable clay such as a Smectite, Veegum F or Bentonite, and is present within the granules of the tablet to provide a tablet which is capable of dispersing in water within 3 minutes to provide a dispersion which will pass through a 710 μm sieve. The tablet also includes cellulosic excipients. The tablet can be optionally film-coated, in which the dispersion time is less than 5 minutes.[41]

Fast Dissolving or Oro-dispersible Tablets

Fast dissolving tablets are solid dosage form containing medical substances which disintegrate rapidly, usually within few seconds when placed upon tongue requiring no additional water to facilitate swallowing. Fast dissolving dosage forms can be disintegrated, dissolved, or suspended by saliva in the mouth Fast dissolving tablets are useful in patients, like pediatric, geriatric, bedridden, or mentally disabled, who may face difficulty in swallowing conventional tablets or capsules leading to ineffective therapy, with persistent nausea, sudden episodes of allergic attacks, or coughing for those who have an active life style.

Mouth-dissolving Tablets

It is a tablet that disintegrates and dissolves rapidly in the saliva within a few seconds without the need of drinking water or chewing. A mouth dissolving tablet usually dissolves in the oral cavity within 15 sec to 3 min. Most of the MDTs include certain super disintegrates and taste masking agents.[42]

Various patents on Fast-dissolving tablets:

1. Boghmans *et al* (2013) worked on "Orodispersible tablets of Erythritol and Isomalt". Erythritol is granulated together with at least 10% w/w Isomalt. Prior and/ or after granulation a disintegrant is added and an orodispersible tablet was prepared. The tablet have a disintegration time more preferably less than 60 seconds and said disintegration time was determined according to the European Pharmacopoeia VI, Test method 2.9.1 by using a pharmaceutical disintegration tester model ZT 73. Where by 6 tablets having a surface of 1 square centimeter and a weight of 350 mg, at a compression force of 20 kn, were analyzed and mean values were calculated. The processes for preparing the orodispersible tablet, its use, and the intermediate granulate are described as well.[43]
2. Faham *et al* (2004) worked on "Orodispersible tablets containing fexofenadine". In his invention, he prepared orodispersible tablets, which are able to disintegrate in the buccal cavity upon contact with saliva by formation of an easy-to-swallow suspension, in less than 60 seconds, preferably in less than 40 seconds, containing Fexofenadine in the form of coated granules, and a mixture of excipients comprising at least one disintegrating agent, a soluble diluents agent, a lubricant and optionally a swelling agent, a permeabilizing agent, sweeteners, flavoring agents and colors; the process for obtaining such orodispersible tablets and the coated granules incorporated therein and the use of said orodispersible tablets in the treatment of seasonal allergic rhinitis[44].

3. Abu-Izza *et al* (2004) worked on "fast dissolving tablets". The invention relates to processes for the preparation of tablets which dissolve rapidly in the mouth and provide an excellent mouth feel. The tablets of the invention comprise a compound which melts at about 37° C. or lower, have a low hardness, high stability and generally comprise few insoluble disintegrants which may cause a gritty or chalky sensation in the month.[45]
4. Murpani *et al* (2003) work on "fast dissolving tablets of cyclooxygenase-2 enzyme inhibitors" and the invention relates to fast dissolving tablets for oral administration comprising a therapeutically effective amount of drug(s) that acts selectively as a cyclooxygenase-2 (COX-2) enzyme inhibitor, which disintegrate quickly in mouth. The tablets are particularly suitable for patients who have difficulty in swallowing.[46]

DECLARATION OF INTEREST

It is hereby declared that this paper does not have any conflict of interest.

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