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A Study of Dispersible Tablet for Enhancement of Bioavailability

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Abstract - Dispersible tablets are designed to dissolve quickly in water, making them an ideal dosage form for patients who have difficulty swallowing tablets or capsules. They are commonly used in the treatment of various medical conditions, including pain, inflammation, and infections. The bioavailability of a drug is the percentage of the drug that reaches the systemic circulation after administration, and it is an important parameter in determining the efficacy and safety of a drug. Therefore, enhancing the bioavailability of a drug can lead to better therapeutic outcomes. There are several strategies for enhancing the bioavailability of drugs, including improving the solubility and dissolution rate of the drug, increasing the permeability of the drug across biological barriers, and reducing the first-pass metabolism of the drug. Dispersible tablets can be used to improve the solubility and dissolution rate of poorly water-soluble drugs, leading to increased bioavailability.

Keyword - Dispersible Tablet, drug

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INTRODUCTION

The primary goal of any DDS research and development effort is to provide patients with a treatment that is both safe and effective. Oral medication delivery has dominated the pharmaceutical industry worldwide for decades. As a preferred method of medicine delivery, its popularity is always on the rise. Manufacturing tablets is now an exact science thanks to several advances in pharmaceutical technology. Tablets, formerly a less popular dosage type, have risen to prominence in recent years. This dosage form is widely used because of its many benefits, including its simplicity to produce and administer, as well as its precision in dosing, stability, and safety. Tablets may be made using a number of different procedures, the most common of which are wet granulation, dry granulation, and direct compression.[1]

Tablets that contain a special formulation, which quickly disintegrates in water to form a drinkable suspension, It provides the ease of swallowing and the enhanced bioavailability of most drug formulations are administered orally in the form of capsules, tablets or fluids. The basic requirement of any drug delivery system is to perform the effective absorption and release of the drug at its absorption site in the gastrointestinal tract. After the absorption of the drug at its site of absorption, the permeation or transport of the drug from an oral dosage form to the blood flow. Tablets continue to be the most common and acknowledged dosage forms due to their incessant improvement and employment of inventive ideas to overcome the fundamental disadvantages of existing formulations. Dispersible tablets are defined as uncoated or film-coated tablets intended to be dispersed in water prior to administration, which provides homogeneous dispersion. Usually, a dispersible tablet is dispersed in water and the subsequent dispersion is given to the patient. Dispersible tablets are a substitute to conventional a formulation with precise dosing. Pharmaceutical active compounds which are not stable in aqueous solution may be stable as a dispersible tablet. The dispersible tablet offers a useful dosage form, decreasing the need for multiple formulations of the same medicine. The innovative concept of a rapidly dispersible drug delivery system stems from the aspiration to provide the patient with a conventional means of taking the drug. In recent times, oral administration of the formulation has become the most popular route of administration due to its comfort of consumption, painlessness, versatility and above all patient compliance.[2]

ORAL DRUG DELIVERY

Oral drug delivery is the most common and convenient method of administering medication to patients. It involves the use of oral dosage forms such as tablets, capsules, suspensions, and solutions that are ingested through the mouth and delivered to the gastrointestinal tract for absorption and distribution throughout the body. The advantages of oral drug delivery include ease of administration, high patient compliance, and low cost compared to other drug delivery methods.

Additionally, oral dosage forms can be formulated to release medication at a controlled rate, ensuring consistent drug levels in the bloodstream. However, oral drug delivery also has some limitations. Some medications may be poorly absorbed or degraded in the acidic environment of the stomach, leading to reduced bioavailability. In addition, certain drugs may be metabolized by the liver before they reach systemic circulation, reducing their effectiveness. To overcome these limitations, various drug delivery technologies have been developed, such as enteric coating to protect drugs from stomach acid, sustained-release formulations for controlled drug delivery, and nanoparticles for targeted delivery..[3]

There are various physicochemical properties such as solubility and permeability of active plays a major role in absorption of formulation. In recent development of new chemical entities (NCEs), more than 40% found the low solubility problem. This is the basic challenge during successful development of new formulation with effective availability of drug to systemic circulation. Development of orally Rapid dispersible/dissolving tablets is an alternative solution to avoid the absorption of drug through GIT such as intraoral route. The drug can be directly administered to systemic circulation by using rapid release of drug in saliva and absorption of drug through oral mucosa. But this dosage form required the effective and rapid release of drug in oral mucosa. The development of such formulation can be achieved by application of several physical and chemical techniques.[4]

ORAL DRUG ABSORPTION

Oral drug absorption is the process by which a drug taken by mouth is absorbed into the bloodstream and transported to its target site in the body. After ingestion, the drug must first pass through the stomach and the small intestine, where it is subject to various physiological processes that can affect its absorption. The drug's chemical properties, formulation, and the presence of food or other drugs can also impact its absorption. Once absorbed, the drug is transported through the bloodstream to the liver, where it may be metabolized before being distributed to its target site. The efficiency and speed of oral drug absorption can vary widely depending on the drug and the individual taking it, which can affect the drug's efficacy and potential side effects.

Drug absorption is determined by physicochemical properties of drugs, their formulations, and routes of administration. When drug is administered orally, it gets absorbed into the circulatory system and then excreted through kidney or may be excreted as metabolites.

- **Gastrointestinal Tract and Different Sites of Drug Absorption**

Oral mucosa: The oral mucosa has a thin epithelium and a rich vascularity that favors absorption, but contact is usually too brief, even for drugs in solution, for appreciable absorption to occur.

Stomach: The stomach has a relatively large epithelial surface, but because it has a thick mucus layer and the time that the drug remains there is usually relatively short, absorption is limited.

Small intestine: The intestine mucosa is characterized by the presence of villi that constitute the anatomical and functional unit for nutrient and drug absorption. The small intestine has the largest surface area for drug absorption in the G.I.T.

- **Factors Affecting Oral Drug Absorption**

Amongst all pharmacokinetics processes, G.I. absorption is the most amenable parameter influenced by myriad factors. These are:

a. Gastrointestinal pH and pKa of drug

b. Gastric emptying process

c. Intestinal motility

d. First pass extraction

e. Food

f. Disease states and other factor

DISPERSIBLE TABLET AS A DOSAGE FORM

A dispersible tablet is a type of dosage form that is designed to dissolve in water or other liquids before ingestion. It is commonly used for medications that are difficult to swallow or have an unpleasant taste, as the tablet can be easily dissolved in a liquid to make it easier to take.

Dispersible tablets are made by compressing the active ingredient and other excipients into a tablet form, which is then coated with a special coating that allows it to disintegrate quickly when exposed to water. This coating is usually made of materials such as starch, sugar, or other polymers that can dissolve easily in water.

Dispersible tablets can be used for a wide range of medications, including antibiotics, pain relievers, and vitamins. They are particularly useful for children, elderly patients, and patients with swallowing difficulties, as they provide a more convenient and palatable way to take medications. To use a dispersible tablet, the tablet is placed in a small amount of water or other liquid and allowed to dissolve completely before drinking. The resulting liquid can then be swallowed, making it easier to take the medication.[5]

Dispersible Tablets is an alternative to the traditional swallow tablet containing a special formulation, which will quickly disintegrate in water to form a suspension that can be drunk. It combines the 1ease of swallowing and the potentially improved bioavailability of a liquid formulation, with the accurate dosing. Active ingredients unstable in aqueous solution may be stable as a dispersible

tablet.

Methods used for Manufacturing Tablet

A tablet with good characteristics is not made on a tablet press; it is made in the granulation process. Joining particles within a given granulation process will improve flow and compression characteristics, reduce segregation, improve content uniformity, and eliminate excessive amounts of fine particles.

- **Wet granulation:** Wet granulation is the process of adding a liquid solution to powders to form granules. The process can be very simple or very complex depending on the characteristics of the powders. The liquid solution can be either aqueous based or solvent based (dries). Once the solvent has been dried and the powders have formed a more densely held mass, then the granulation is milled. [6]

- **Dry granulation:** The dry granulation process is used to form granules without using a liquid solution because the product to be granulated may be sensitive to moisture and heat. Forming granules without moisture requires compacting and densifying the powders.

Bio-pharmaceutics Classification Scheme

The Biopharmaceutics Classification System (BCS) is a scientific framework for classifying drug substances based on their aqueous solubility and intestinal permeability. The BCS classifies drugs into four classes: class I (high solubility, high permeability), class II (low solubility, high permeability), class III (high solubility, low permeability), and class IV (low solubility, low permeability). This classification system is important because it can help predict the pharmacokinetic behavior of a drug in the body, which can affect its efficacy and safety. For example, drugs in class II may have poor bioavailability due to low solubility, while drugs in class III may have poor absorption due to low permeability. Understanding a drug's BCS class can inform the formulation and development of new drugs, as well as aid in regulatory decision-making.

1. **Aceclofenac:**

Aceclofenac is a non-steroidal anti-inflammatory drug (NSAID) that is commonly used to relieve pain and inflammation in conditions such as arthritis, osteoarthritis, and rheumatoid arthritis. It works by blocking the action of cyclooxygenase enzymes which produce prostaglandins that cause pain and inflammation. Aceclofenac is available in tablet form and should be taken as prescribed by a healthcare professional. Like all NSAIDs, it can have side effects, including stomach ulcers, bleeding, and kidney problems, and should be used with caution in people with a history of these conditions.

2. **Crospovidone:**

Crospovidone is a commonly used pharmaceutical excipient that is used as a disintegrant in tablets and capsules. It works by absorbing water and swelling, which helps to break apart the tablet or capsule and release the active ingredient. Crospovidone is a synthetic polymer that is chemically crosslinked to create a three-dimensional network of pores. It is a widely used excipient due to its effectiveness, compatibility with a wide range of active ingredients, and ease of use in tablet and capsule formulations.

3. **Sodium starch glycolate:**

Sodium starch glycolate is another commonly used pharmaceutical excipient that is used as a disintegrant in tablets and capsules. Like crospovidone, it works by absorbing water and swelling to break apart the tablet or capsule and release the active ingredient. Sodium starch glycolate is derived from corn starch and is chemically modified to create a crosslinked polymer with a high degree of swelling capacity. It is widely used due to its effectiveness, compatibility with a wide range of active ingredients, and low cost.

4. **Guar gum:**

Guar gum is a natural polymer derived from the seeds of the guar plant. It is commonly used in the food and pharmaceutical industries as a thickener, stabilizer, and emulsifier. In pharmaceuticals, it is used as a binder in tablet formulations to help hold the tablet together and improve its hardness and durability. Guar gum is generally considered safe for use in pharmaceuticals, although it can cause allergic reactions in some people.

5. **Ispaghula:**

Ispaghula, also known as psyllium, is a natural fiber derived from the seeds of the Plantago ovata plant. It is commonly used as a bulk-forming laxative to relieve constipation and improve bowel movements. In pharmaceuticals, it is also used as a binder and disintegrant in tablet formulations. Ispaghula is generally considered safe for use in pharmaceuticals, although it can cause gastrointestinal side effects such as bloating and flatulence. It should be used with caution in people with intestinal obstruction or inflammatory bowel disease.

Ideal Properties of Rapid Dispersible or Fast Dissolving Tablets

- Ideally Rapid dispersible tablets do not require water or less amount of water for oral administration, the formulation should be easily

disintegrated or dissolve in oral cavity within a few seconds.

- The formulation should have sufficient hardness and should be free from any friability problem to match the rigors of the manufacturing process and handling of finished product by target patient.
- The drug loading capacity of rapid dispersible tablets should be high.
- The formulation should have been free from any bitter or unpleasant taste with better organoleptic properties.[10]
- The formulation should be rapidly disintegrate or dissolve after oral administration in the oral cavity for rapid action.
- It should be stable with low manufacturing cast and the process Should be amenable to existing processing and packaging machineries.
- It should be Cost-effective.
- Avoidance of first pass effect which improves bioavailability of rapid dispersible tablets.

It should have more stability as compare to liquid dosage forms

Advantages of Dispersible Tablets

Dispersible tablet should have:

- Easier to swallow than drugs in solid dosage forms (like tablet, capsule etc.)
- Quick on set of action
- Improved bioavailability
- Good chemical stability
- Ease of use in ambulatory treatment. It can be easily administered to geriatric, pediatric and mentally disabled patients
- Accuracy of unit dosage form
- Rapid dispersion of excipients
- Taste masking
- Increases surface area which may increase dissolution rate
- Improve the texture and appearance

a. Best suited to large scale production

b. Low manufacturing cost

CONCLUSION

Making dispersible tablets using direct compression was determined to be the most efficient way. Direct compression was shown to have a quicker disintegration time and disintegration rate compared to wet/dry granulation. The formulation with crospovidone exhibited greater release than tablet sodium starch glycolate, while the formulation with Ispagula showed higher release than tablet sodium starch glycolate. One significant pharmaco-economic benefit of direct compression is its low production cost. Wet/dry pelletizing helps improve output by decreasing the length of the production cycle and the number of workers needed to get the job done. The decrease in the number of processing stages is an indirect advantage, as is the assurance of quality compliance.

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