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Formulation and Characterization of Solid Tablets Using Solid Dispersion Matrix Technology: A Systematic Literature Review

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A B S T R A C T

The formulation of solid tablet preparations using solid dispersion matrix technology involves the selection of active ingredients, polymer matrices, fillers or enhancers, and lubricants. The active ingredient is the drug component that provides a therapeutic effect to the patient. This study aimed to conduct a systematic review study to explore the formulation and characterization of solid tablet dosage forms using solid dispersion matrix technology. The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the formulation and characterization of solid tablet preparations using solid dispersion matrix technology. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations. Solid dispersion matrix technology is one of the approaches used in the formulation of pharmaceutical preparations, especially solid tablets, to achieve controlled and effective drug release. In this technology, the drug is dispersed homogeneously in a solid polymeric matrix, which acts as a binding agent. The basic principle of solid dispersion matrix technology is that the drug is delivered via gradual release from the polymer matrix.

1. Introduction

Solid tablet dosage forms are one of the most common and effective pharmaceutical dosage forms in delivering drugs to patients. Solid dispersion matrix technology is an approach used in a solid tablet formulation to achieve controlled and effective drug release. In this technology, the drug is dispersed homogeneously in a solid polymeric matrix, which acts as a binding agent. The formulation of solid tablet preparations using solid dispersion matrix technology involves the selection of active ingredients, polymer matrices, fillers or enhancers, and lubricants. The active ingredient is the drug component that provides a therapeutic effect to the patient. The polymer matrix acts as a binder to bind the active ingredients and form a homogeneous solid matrix. Fillers or enhancers may be added to provide strength and physical stability to the tablet, while lubricants assist in the release of the tablet from the mold and reduce friction between the particles in the formulation.[1-3]

The formulation process includes mixing the active ingredients with the polymer matrix and fillers in a blender. Then, lubricant is added to the mixture to achieve uniform distribution. If necessary, granulation is carried out to form granules that are easier to compact. Granulation can be carried out by wet or dry methods, depending on the characteristics of the material and the formulation used. After the granules are formed, drying, sieving, and compacting processes are carried out in the machine tableting to produce

solid tablets. The characterization of solid tablet preparations with solid dispersion matrix technology involves various important parameters. Some of the parameters commonly evaluated include tablet weight and thickness, weight uniformity, hardness, drug release, and physical stability. Tablet weight and thickness are measured to ensure consistent dosing and good physical integrity. Weight uniformity is checked to ensure uniformity in tablet weight. Tablet hardness is tested to ensure that the tablet is strong enough and not easily crushed. Drug release tests are carried out to determine how quickly the active ingredients are released from the solid dispersion matrix, which is important for achieving the desired therapeutic effect. The physical stability of the preparations is also evaluated through storage tests under different conditions to ensure that the tablets remain stable in terms of color, hardness, and friability.[4-7] This study aimed to conduct a systematic review study to explore the formulation and characterization of solid tablet dosage forms using solid dispersion matrix technology.

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the formulation and characterization of solid tablet preparations using solid dispersion matrix technology. The search was performed using the terms: (1) "formulation" OR "characterization" OR "solid tablet" OR" solid tablet dispersion" AND (2) " solid dispersion matrix technology ". The literature is limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about formulation and characterization of solid tablet preparations using solid dispersion matrix technology, the control group only received liquid without therapeutic effect or no treatment, studies were conducted in a timeframe from 2000-2023, and the main outcome was the comparison of formulation and characterization of solid tablet preparations using solid dispersion matrix technology. Meanwhile, the exclusion criteria were animal models that were not related to the formulation and characterization of solid tablet preparations using solid dispersion matrix technology, the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

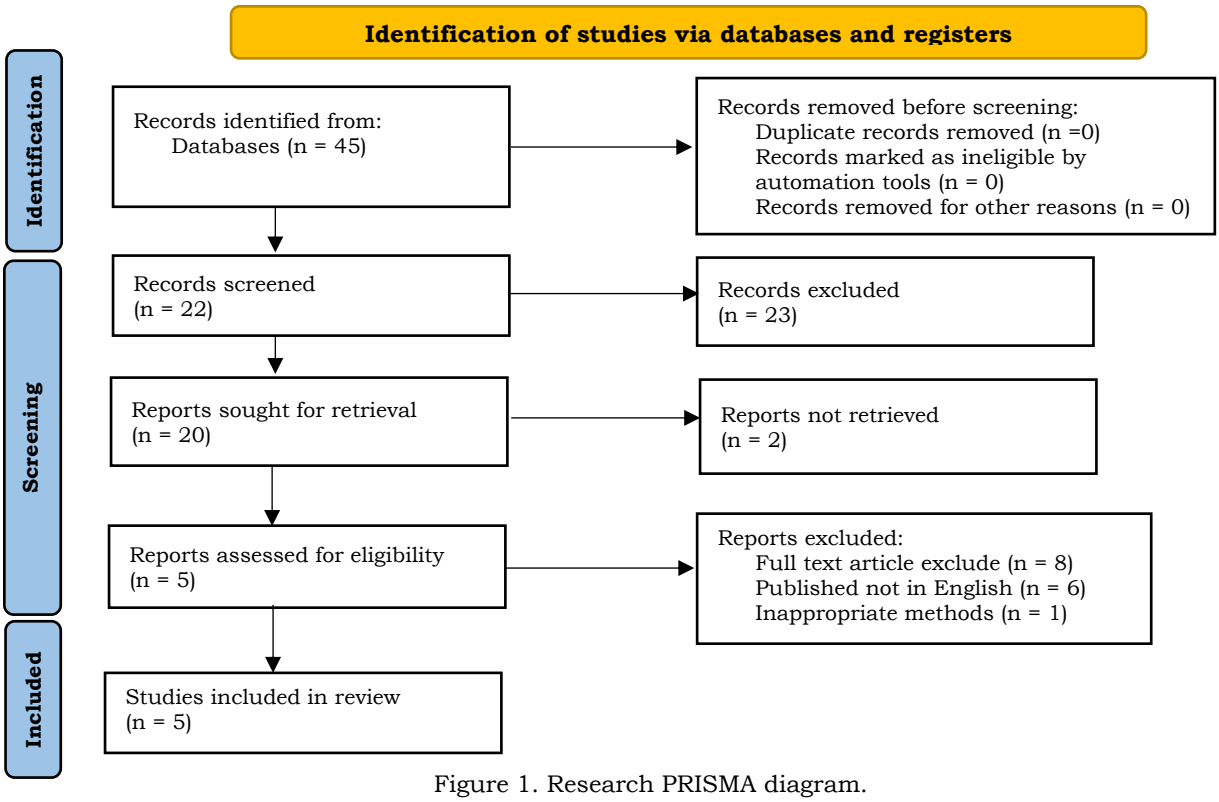

Figure 1. Research PRISMA diagram.

3. Results and Discussion

Solid dispersion matrix technology

Solid dispersion matrix technology is one of the approaches used in the formulation of pharmaceutical preparations, especially solid tablets, to achieve controlled and effective drug release. In this technology, the drug is dispersed homogeneously in a solid polymeric matrix, which acts as a binding agent. The basic principle of solid dispersion matrix technology is that the drug is delivered via gradual release from the polymer matrix. When the tablet is consumed, water or body fluids enter the tablet and interact with the polymer matrix. Over time, water seeps into the matrix and causes swelling and gelation of the polymer matrix.[8-10]

This swelling and gel formation helps regulate the rate of drug release. The drug in the polymer matrix will dissolve or diffuse into the surrounding medium, then slowly released into the digestive system. The polymer matrix acts as an inhibitor for drug release, allowing finer control of the rate of drug release. The main advantage of the solid dispersion matrix technology is its ability to produce controlled and regulated drug release. By adjusting the composition of the polymer matrix, the size of the drug particles, and other physical properties of the material, it is possible to achieve a release profile suitable for therapeutic requirements. This technology allows for the regulation of the rate of drug release over a long period of time, including step-release, immediate-release, or a combination of both.[11]

In addition, solid dispersion matrix technology can also improve drug bioavailability. By reducing the rate of drug release, the contact time between the drug and the intestinal mucosa can be prolonged, allowing better drug absorption. Several polymers that are often used in solid dispersion matrices include hydroxypropyl methylcellulose (HPMC), carbopol, ethyl cellulose, and polyvinyl pyrrolidone (PVP). Selection of the appropriate polymer depends on the physicochemical characteristics of the drug to be formulated and the desired release profile. Solid dispersion matrix technology has been widely applied in the pharmaceutical industry to produce tablets with desired therapeutic effects. In the formulation of solid tablet dosage forms by this technology, it is important to carry out careful characterization to ensure quality, stability, and proper drug release in the tablet dosage form.[12-15]

Formulation and characterization of solid tablets using solid dispersion matrix technology

The formulation and characterization of solid tablet dosage forms by solid dispersion matrix technology involve important steps to ensure quality, stability, and proper drug release. Determination of active ingredients to be used in tablets, where preferably the active ingredients must be dispersed homogeneously in the polymer matrix. It is preferable to select the active ingredient with the appropriate solubility and desired release profile. Select a suitable polymer matrix to bind the active ingredients and control drug release. Some of the polymers that are often used include hydroxypropyl methylcellulose (HPMC), carbopol, ethyl cellulose, and polyvinyl pyrrolidone (PVP). Also, pay attention to fillers or enhancers such as lactose, microcrystalline cellulose (MCC), or silica to provide strength and physical stability to the tablet. Excipients can also affect the drug release profile. Note the addition of a lubricant such as magnesium stearate or stearic acid to facilitate the release of the tablet from the mold and reduce friction between the particles in the formulation.[16-18]

The characterization process includes assessing tablet weight and thickness to ensure consistent dosing and good physical integrity. In addition, the characterization process includes uniformity of tablet weight and hardness. Furthermore, drug release tests were carried out as with the corrosive method. Evaluation of the physical stability of tablets through storage tests in various conditions such as different temperatures and humidity. Check for physical changes such as discoloration, hardness, or friability of the tablet.[19,20]

Illustration of formulation and characterization process with solid dispersion matrix technology

Following are general examples of formulation and characterization of solid tablet dosage forms using solid dispersion matrix technology: (1) Ingredients: Active ingredient: Paracetamol; Polymer matrix: Hydroxypropyl methylcellulose (HPMC); Fillers: Lactose monohydrate; Lubricant: Magnesium stearate. (2) Formulation process: a. Mixing: Mix 500 mg paracetamol, 150 mg HPMC, and 100 mg lactose monohydrate in a blender until homogeneous. b. Granulation: Add water gradually to form granules that are easier to compact. Dry the granules using an oven at a low temperature. c. Screening and Compaction: Filter the granules using a sieve of the desired particle size. Compress the granules into tablets using a tableting machine. (3) Characterization: a. Tablet weight and thickness: Measure the weight and thickness of 10 random tablets using a balance and micrometer. b. Weight uniformity: Measure the weight of 20 tablets at random to ensure weight uniformity. c. Hardness: Use a hardness tester to measure the hardness of the tablet. Take 5 tablets at random and measure their hardness. d. Drug Release: Perform a drug release test using a corrosive method. Place 6 tablets in a corrosive medium and take samples at certain time intervals to measure the amount of paracetamol released. e. Physical Stability: Store the tablets under suitable storage conditions, such as room temperature and humidity control, for up to 3 months. Check for physical changes such as discoloration, hardness, or friability of the tablet.

4. Conclusion

Solid dispersion matrix technology is one of the approaches used in the formulation of pharmaceutical preparations, especially solid tablets, to achieve controlled and effective drug release.

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