A Review on Revolutionize Drug Delivery with Spansules

Bhadoriya A.,* Shukla T.
Institute of Pharmacy, SAGE University, Indore, India
Email: abhilashabhadoriya@gmail.com

Received 22 May 2023, Accepted for publication 31 May 2023, Published 30 June 2023

ABSTRACT

This article provides a brief overview of Spansules, a novel drug delivery system. Spansules are designed to release medication in a controlled manner, providing a sustained and consistent therapeutic effect. This delivery method involves encapsulating the drug in a special coating that dissolves slowly, allowing the medication to be released gradually over time. Spansules have been shown to improve patient compliance and reduce side effects associated with traditional drug delivery methods. Spansules are classified as an Advanced Drug Delivery System due to their ability to facilitate controlled and sustained release of medication over an extended duration. Spansules can be utilized for the delivery of multiple drugs in a single dosage form, while also providing sustained release. The Spansules product offers a multi-drug regimen capability, which enables the administration of multiple drugs in a single dosage form, providing added benefits. Spansules are a type of biphasic release drug delivery system that enables the administration of medication in both immediate and sustained release forms. In situations where a patient necessitates prompt alleviation of symptoms followed by sustained management over an extended duration, these systems can prove to be advantageous. In general, Spansules represent a versatile and efficacious mechanism for drug delivery that can offer numerous advantages to both patients and healthcare providers. Overall, Spansules represent a promising advancement in the field of drug delivery.

Keywords: Spansules, Biphasic, Controlled Release, Sustained Release, Drug.

INTRODUCTION

Spansules refer to a sophisticated drug delivery system that entails enclosing an active component within a capsule shell in the form of granules or micro particles of different sizes. The aforementioned capsule variety serves the purpose of safeguarding the granules or active ingredient from external factors and facilitates the release of medication at a predetermined time. The design and manufacture of dosage forms are faced with a new challenge in the form of Spansules. This requires the utilization of various skills, experience, advanced technologies, and specialized equipment. In 1952, Smith Kline & French introduced Spansules as a timed-release formulation. This led to a widespread exploration for other potential applications in the development of dosage forms. Spansules possess several potential advantages over conventional dosage forms. They have the ability to optimise drug delivery over an extended period of time and can deliver various medicaments with minimal side effects.

Spansules refer to a drug delivery system that facilitates the gradual release of medication over an extended duration. Spansules consist of miniature beads or pellets that are enveloped in a distinct polymer coating. This coating gradually dissolves, enabling the drug to be gradually discharged into the body. Spansules are frequently employed to manage chronic medical conditions like hypertension, diabetes, and psychiatric disorders. Spansules are designed to gradually

* Corresponding author: Abhilasha Bhadoriya
E-mail address: abhilashabhadoriya@gmail.com

www.ijnrph.com
release medication, resulting in a consistent therapeutic concentration of the drug in the body. This controlled release mechanism can enhance treatment efficacy and minimize the likelihood of adverse reactions. Spansules are offered in diverse formulations such as capsules, tablets, and pellets. Prescription medications are usually recommended by a healthcare professional and must be consumed precisely as instructed to achieve the best possible treatment results.[3]

Spansules are a type of drug delivery system that is formulated to release one or more drugs in a controlled manner over a predetermined period of time. Pharmaceutical products are commonly composed of granules or pellets that comprise of one or more active pharmaceutical ingredients (APIs). These granules or pellets are enveloped with a slow-dissolving polymer that regulates the release of the medication. The drug release pattern is determined by the coating of the Spansules, which can be customized to release the medication at predetermined intervals. The medication is released in a controlled and sustained manner over a prolonged duration.[2] This approach can enhance treatment efficacy and minimize the likelihood of adverse effects. Spansules are a range of pharmaceutical formulations that come in different dosage forms, including capsules, tablets, and pellets. They are frequently prescribed for the management of chronic medical conditions, such as hypertension, diabetes, and psychiatric disorders, that require prolonged medication.

**Advantages of spansules**

Spansules present various benefits when compared to alternative forms of medication administration, such as:

- Spansules can enhance patient compliance with their medication regimen by reducing dosing frequency and offering a more convenient dosing schedule.
- Spansules have the ability to regulate the release of medication, which can result in a decrease in the likelihood of side effects. This is due to the maintenance of a steady therapeutic level of the medication in the body.
- The delivery profile of Spansules can be altered to release medication at specific intervals, thereby enhancing the efficacy of treatment.
- Spansules have the ability to enhance bioavailability by controlling the release of medication. This controlled release can improve drug degradation in the gastrointestinal tract (GIT), leading to better absorption of the medication.
- Spansules have the capability to be formulated for taste masking of medications. This feature can be advantageous for patients who experience difficulty in swallowing tablets or capsules.

**Limitation of spansules**

Spansules have some limitations, including:

- The correlation between the in vitro release characteristics of Spansules and their in vivo performance is not well-established due to limited available data.
- The use of Spansules entails a risk of dose dumping in the event of damage or compromise. Dose dumping refers to the rapid release of medication, which can result in adverse effects.
- The Spansules dosage form exhibits reduced systemic availability in comparison to other forms of medication due to its gradual and prolonged release of the drug over an extended period.[4]
The Spansules formulation is intricate and demands proficient labor for its production, leading to an escalation in cost.

The cost of Spansules is relatively high compared to other dosage forms. This is attributed to the intricate formulation process and specialized equipment necessary for its production.

Drug release from Spansules

A coating with selective permeability to water and other solvents is produced using different polymers. This coating enables the controlled release of drugs at a specific rate. The coating has been formulated to exhibit sensitivity towards alterations in pH levels or enzymatic activity within the gastrointestinal tract, thereby facilitating its dissolution or disintegration. Improper design of the coating can result in limitations such as dose dumping or incomplete drug release. It should be noted that Spansules may not be universally applicable to all drug types or formulations. This is because certain drugs may necessitate immediate release or specific delivery systems, as stated in reference.[5]

METHODS OF PREPARATION OF GRANULES FOR SPANSULES

Spansules can be prepared by the following methods:

1. Coacervation-phase separation

The coacervation-phase separation technique is employed in the development of microencapsulated drug delivery systems. The process consists of three primary stages:

The initial stage of the process involves the selection of an appropriate polymer and its dissolution in a solvent to produce a polymer solution. The polymer must possess the capability to generate a coacervate phase upon being combined with an appropriate coacervating agent. Coacervation is a process in which a coacervating agent is added to a polymer solution. This agent causes the solution to separate into two distinct phases: a dense coacervate phase that is rich in polymer and a dilute supernatant phase. Phase separation is a phenomenon that arises from alterations in the solvent conditions, such as variations in pH, temperature, or ionic strength.

Encapsulation involves utilizing the coacervate phase to enclose the drug or active ingredient. The addition of the drug to the coacervate phase or the dissolution of the drug in the supernatant phase prior to mixing with the coacervate phase are two methods that can be employed to achieve this. The drug is encapsulated within the coacervate phase, which serves as a shielding layer.

The microcapsules obtained exhibit a core-shell configuration, wherein the active ingredient or drug is located in the core and is enveloped by the coacervate phase, which forms the shell. The process described can be utilized to regulate the gradual dispensation of drugs and safeguard them from deterioration within the human body.[6]

2. Spray drying

The process of spray drying is a frequently employed technique for the purpose of coating drug particles or granules. The process involves dissolving or suspending the drug in a coating material, which is subsequently atomized into a heated chamber as a fine mist. As mist droplets traverse the chamber, the solvent undergoes evaporation, resulting in the formation of a desiccated, coated particle or granule. Upon exposure to hot air, the coating undergoes solidification and envelops the drug in a thin film. [6]

The process of spray drying is a swift and uncomplicated method that is suitable for substances that are sensitive to heat and may be adversely affected by prolonged exposure to high temperatures. The process of manufacturing coated drug particles or granules using this method is
highly scalable, which has contributed to its widespread adoption in large-scale production.

3. Spray congealing

Spray congealing is a process that involves melting a substance at high temperatures and subsequently atomizing it through a nozzle. The resulting droplets are then solidified by passing them through a cool air stream. Solidification of the coating occurs through thermal congealing of the molten coating material, as opposed to the solvent evaporation method used in spray drying. The aforementioned technique is especially advantageous for substances that are vulnerable to heat and cannot endure elevated temperatures while being coated.

4. Pan coating

The pan coating technique is a widely utilized approach for the application of a coating onto small particles or pellets. Particles that have a diameter exceeding 600 microns are deemed essential for achieving a successful coating. The coating process involves the rotation of particles within a coating pan, while a gradual application of coating material is administered. Typically, the active ingredient is coated onto spherical particles of varying sizes and materials. The solid core material is coated by atomizing spray application of the coating solution. The coated materials are subjected to a stream of warm air to eliminate the coating solvent. The aforementioned procedure is iterated multiple times until the intended coating thickness is attained. The pan coating technique is a commonly employed and economical approach for coating particles, particularly in the pharmaceutical sector.[6]

5. Solvent evaporation

The technique of solvent evaporation is frequently employed in the production of microcapsules. The coating material is dissolved in a volatile solvent that is immiscible with the liquid vehicle phase during the aforementioned process. The coating solution is stirred to achieve particles of uniform size after the addition of a core material. The size of the granules can be regulated by adjusting the stirring velocity, the concentration of the coating substance, and the solvent category employed. The solvent evaporation method allows for the utilization of diverse film-forming polymers as coating materials. The listed examples are polyvinylpyrrolidone, polyethylene, polyvinyl alcohol, and polyacrylic acid. The selection of the coating material is contingent upon the intended characteristics of the microcapsules, including but not limited to stability, release rate, and compatibility with the core material. The process of solvent evaporation is a flexible and expandable technique utilized for producing coated granules. It is extensively employed in diverse domains, including drug delivery, food and beverage, and personal care products. This method is well-documented in literature.

6. Fluidized bed technology

Fluidized bed technology is a process employed to apply a liquid coating material onto particles. The process involves suspending particles within a chamber that contains a swiftly flowing upward stream of air or gas. The fluidization of particles occurs when gas flows through them, causing them to behave like a liquid. This results in a homogeneous mixing of particles. The fluidized particles are coated with a uniform layer of liquid coating material through the process of spraying. The high temperature and airflow cause the liquid coating material to evaporate quickly, resulting in the formation of an outer rigid layer on the particles with the desired thickness. The agitation of particles is maintained throughout the process to achieve a consistent coating.

Fluidized bed technology is a versatile method for coating particles of different types, including powders, granules, and pellets, with a variety of coating materials, such as polymers, waxes, sugars, and other agents. This technique presents various benefits, such as consistent coating thickness,
Elevated coating efficacy, and regulated discharge of the active components. Fluidized bed technology finds extensive application in diverse industries such as pharmaceuticals, food processing, agriculture, and cosmetics, for the manufacture of coated particles. According to reference[4], the method is scalable and can be seamlessly incorporated into a manufacturing process.

EVALUATION OF SPANSULES

1. Particle size

The measurement of particle size is a crucial factor in both the manufacturing and analysis of granules. This parameter has a significant impact on a range of properties, including but not limited to flowability, compressibility, and dissolution rate. Multiple methods exist for determining the particle size distribution of granules. The process of determining particle size is commonly achieved through the use of sieve analysis, which is a straightforward and commonly employed technique. The process entails the segregation of particles by their size utilizing a series of mesh sieves that possess varying pore sizes. The granules undergo a process of sieving, wherein the particles are separated by size using a series of sieves. The weight of the particles that are retained on each individual sieve is then determined through measurement. The determination of particle size distribution involves the computation of weight percentages of particles that are retained on individual sieves.

Particle size determination can be achieved through the utilization of various techniques, including static laser light scattering analysis and dynamic light scattering. The techniques employed in this process entail the quantification of the intensity of light scattering caused by particles present in a given sample. Information regarding the size and shape of particles can be obtained through the analysis of scattered light. The aforementioned methods are highly advantageous in ascertaining the dimensions of diminutive particles, spanning from a few nanometers to a few micrometers. The granule particle size in Spanules can be analyzed using a simple sieve analysis method. The use of sieve analysis is a cost-effective and accurate method for determining particle size in Spanules, which typically contain larger particles. For particle sizes that are smaller, alternative techniques such as static laser light scattering analysis and dynamic light scattering may be more appropriate.[7]

2. Moisture content

The determination of moisture content can be achieved through the measurement of weight loss of a sample following heating under specific conditions. The weight loss is directly proportional to the moisture content of the sample.

The formula to calculate the moisture content is as follows:

\[
\text{Moisture content} = \frac{(\text{Wet weight} - \text{Dry weight})}{\text{Dry weight}} \times 100\%
\]

Where,

- Wet weight = weight of the sample before heating
- Dry weight = weight of the sample after heating

The initial step involves measuring the weight of the specimen while it is still damp. Subsequently, the sample is subjected to predetermined environmental conditions to eliminate any residual moisture. Following the heating process, the sample is re-weighed in its dehydrated state. The formula mentioned above is utilized to calculate weight loss, which provides the percentage of moisture content in the given sample. The optimal heating parameters are contingent upon the sample type and the employed methodology. The Karl Fischer titration method involves heating the sample to a predetermined temperature and combining it with a reagent to measure the moisture content. The oven-drying method involves subjecting the sample to a specific
temperature and duration in an oven to eliminate any moisture present. To ensure precise outcomes, it is crucial to meticulously adhere to the particular requirements of each technique as stated in reference.[7]

3. Friability testing

The assessment of physical integrity and stability of solid dosage forms, such as tablets, capsules, and granules, is crucially determined by the process of Friability testing. The test assesses the vulnerability of the dosage form to impairment while being handled and transported. To determine the friability of Spansules, the following calculation can be used:

A. A procedure for conducting friability testing involves measuring 10 grams of Spansules and transferring them into the friabilator.

B. The Spansules should be subjected to a rotational speed of 25 revolutions per minute for a duration of 4 minutes or 100 revolutions using the friabilator.

C. After a duration of 4 minutes or 100 revolutions, the Spansules should be taken out from the friabilator and weighed again.

D. Calculate the percentage weight loss using the following formula:

\[
\text{Friability (\%)} = \left(\frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}}\right) \times 100
\]

Where:

Initial weight = Weight of Spansules before the test

Final weight = Weight of Spansules after the test

A friability value below 1% is typically deemed satisfactory for various dosage forms, including Spansules. A friability value exceeding 1% signifies that the Spansules are highly vulnerable to harm during their handling and transportation. This can result in a decrease in their effectiveness and quality.[8]

4. In vitro release studies from spansules

The assessment of drug release properties of a dosage form in a controlled laboratory environment is crucial, and in vitro release studies serve this purpose. Dissolution studies are a frequently employed method for conducting in vitro release investigations. Calibrated dissolution apparatuses, such as the USP apparatus I (basket), apparatus II (paddle), or apparatus IV (flow-through cell), are utilized for conducting dissolution studies. During dissolution studies, the spansules containing the drug are immersed in a dissolution medium. This medium is usually composed of a buffer solution or simulated biological fluids. The temperature of the dissolution medium is regulated and kept constant while being agitated at a consistent rate. Drug release is monitored through the process of withdrawing samples of the dissolution medium at regular intervals and subjecting them to drug content analysis.[9]

The UV spectrophotometer is a prevalent tool utilized for drug analysis in dissolution studies. UV spectrophotometry is a non-invasive method that enables the examination of drugs in the dissolution medium without requiring intricate sample preparation. The determination of drug concentration in the dissolution medium can be achieved by utilizing a UV spectrophotometer to measure the absorbance of the sample at a specific wavelength. The drug release profile can be determined through the creation of a graph that plots the percentage of drug released against time, as stated in reference.[10]

FUTURE PROSPECTS

Spanules have demonstrated favorable outcomes within the realm of sophisticated drug delivery systems, and their potential for future advancements appears to be highly optimistic. Spanules possess several advantages, including the
capacity to administer multiple drugs in a single dosage form and to improve patient adherence while reducing adverse effects. Targeted drug delivery can be achieved through the use of Spanules. This involves coating particles with a layer that can specifically target the intended site of action within the body. The implementation of this approach can result in a decrease in the necessary dosage and a reduction in the occurrence of adverse effects.

The utilization of Spanules is not limited to conventional drug delivery methods. It can also be employed for the development of site-specific drug delivery systems, which target specific areas of the body, such as the lungs or colon. The implementation of this approach can lead to a reduction in the necessary dosage and a decrease in the occurrence of adverse effects. Combination therapy can be achieved through the use of Spanules, which are capable of delivering multiple drugs concurrently. This approach is particularly useful in the treatment of intricate diseases that necessitate a combination of drugs. Spanules have the potential to enhance the bioavailability of drugs by regulating their release rate and safeguarding them from degradation in the gastrointestinal tract.

The utilization of Spanules can be extended to diverse drug delivery systems, including liposomes, nanoparticles, and microspheres, as a novel approach to drug delivery.

CONCLUSION

In conclusion, spanules are a specific type of dosage form that contains one or multiple active ingredients enclosed within a capsule shell in the form of granules or particles. The granules are enveloped by a dense layer that shields the active pharmaceutical ingredient from external factors. The drug is released at a predetermined pace. Spanules are a novel domain in the realm of sophisticated drug delivery systems. Their development necessitates the expertise of proficient specialists, cutting-edge technologies, and specialized equipment. Notwithstanding the aforementioned requirements, Spanules are deemed to be comparatively uncomplicated to produce and present potential advantages over traditional forms of medication. In the field of advanced drug delivery systems, Spanules are considered a promising area of research and development. In summary, Spanules exhibit promising prospects in the domain of drug delivery systems. Their ability to deliver drugs to specific sites and targets, facilitate combination therapy, and enhance bioavailability renders them a viable option for upcoming drug delivery applications.

Conflicts of Interest: The authors declare no conflict of interest.

ACKNOWLEDGEMENT: The authors would like to acknowledge Institute of Pharmacy, SAGE university, Indore for providing the facilities and support to conduct the review work..

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