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Review Article

Pharmaceutical Suspensions: A Review Article

Shahdab Hashmi*, Rajesh Kumar, Ajeet Pal Singh, Amar Pal Singh, Gaurav Hastir

St. Soldier Institute of Pharmacy, Lidhran Campus behind NIT (R.E.C), Jalandhar-Amritsar Byepass, Jalandhar 14001, Punjab, India

Pharmaceutical formulations, like suspensions, play a crucial role in drug delivery. Due to their structural instability, various challenges arise during the development of these formulations. They typically consist of fine solid particles, ranging from 0.5 µm to 5.0 µm, which are suspended in a suitable vehicle, such as a liquid or semi-liquid, serving as the continuous phase. Suspensions have been utilized and marketed for many years; however, they face stability-related challenges that modern approaches and techniques, such as polymer-coated supensions, nanosuspensions, and encapsulation, aim to overcome.

Keywords: Pharmaceutical Suspensions.

INTRODUCTION

Suspensions are coarse dispersion systems in which finely divided insoluble solid particles are uniformly distributed throughout a liquid vehicle. The solid particles represent the internal phase, while the liquid medium acts as the external phase. In oral suspensions, aqueous vehicles are commonly used, whereas non-aqueous or oily vehicles are preferred for non-oral preparations. Because of stability concerns during storage, many suspensions are supplied as dry powders that require reconstitution before administration [1]. An ideal suspension should maintain uniform particle distribution and allow easy redispersion of sediments upon shaking. Viscosity-enhancing agents are often incorporated to reduce the settling rate and improve physical stability. Smaller particle sizes are preferred to produce smooth and elegant formulations while avoiding grittiness [2]. Particle size also plays a significant role in topical, ophthalmic, and parenteral suspensions, as excessively large particles may cause irritation, discomfort, or administration difficulties [3,4].

Classification of Pharmaceutical Suspensions

1. Oral Suspensions

Oral suspensions are pharmaceutical preparations containing finely divided insoluble particles dispersed in a liquid medium, intended for ingestion. They are a common dosage form, particularly for children, the elderly, and individuals with difficulty swallowing tablets or capsules.

Benefits of Oral Suspensions

Improved Patient Compliance: Suspensions can be easier to swallow than tablets or capsules, especially for children and individuals with swallowing difficulties.

Taste Masking: The liquid medium can help to mask unpleasant tastes of certain drugs.

Controlled Release: Some suspensions can be formulated to achieve controlled release of the drug, providing sustained therapeutic effects.

Enhanced Bioavailability: Suspensions can improve the bioavailability of certain drugs by increasing their absorption rate.

Categories of Oral Suspensions

a. **Ready-to-Use Suspensions:** These are pre-prepared suspensions that are ready for immediate use. They typically come in bottles or single-use sachets.
b. **Powdered Suspensions:** These are dry powders that are reconstituted with a suitable liquid before use. This allows for flexibility in dosing and storage.

2. Suspensions for Topical Use

Topical suspensions are pharmaceutical preparations designed to be applied to the skin or mucous membranes for local or systemic effects. They consist of finely divided insoluble particles dispersed in a liquid medium. These suspensions offer several advantages over other topical formulations:

Benefits of Topical Suspensions

- **Controlled release:** Suspensions can provide a controlled release of the active ingredient, ensuring prolonged action.
- **Improved absorption:** The suspended particles can enhance absorption through the skin or mucous membranes.
- **Taste masking:** For oral suspensions, they can mask unpleasant tastes.
- **Visibility:** The visible particles can aid in application and monitoring.

Categories of Topical Suspensions

- **Lotions:** Thin, fluid suspensions that are easily spreadable.
- **Creams:** Thicker, semi-solid suspensions that offer better coverage.
- **Ointments:** Greasy suspensions that provide a protective barrier.
- **Pastes:** Thick, stiff suspensions that are used for protective and therapeutic purposes.

3. Parenteral Drug Suspensions

Parenteral suspensions are pharmaceutical preparations designed for injection into the body. They consist of finely divided insoluble particles dispersed in a liquid medium. These suspensions offer several advantages over other parenteral formulations:

Benefits of Parenteral Suspensions

- **Controlled release:** Suspensions can provide a controlled release of the active ingredient, ensuring prolonged action.
- **Improved bioavailability:** Certain drugs may have enhanced bioavailability when administered as suspensions.
- **Reduced dosing frequency:** For drugs with a long half-life, suspensions can reduce the frequency of injections.

Depot effect: Some suspensions can create a depot effect, releasing the drug gradually over time.

Categories of Parenteral Suspensions

- **Injectable suspensions:** These are commonly used for intramuscular or subcutaneous injection.
- **Intravenous suspensions:** These are less common but can be used for certain drugs, such as certain vaccines

4. Ophthalmic Drug Suspensions

Ophthalmic suspensions are pharmaceutical preparations designed for application to the eye. They consist of finely divided insoluble particles dispersed in a liquid medium. These suspensions offer several advantages over other ophthalmic formulations:

Benefits of Ophthalmic Suspensions

- **Controlled release:** Suspensions can provide a controlled release of the active ingredient, ensuring prolonged action.
- **Improved bioavailability:** Certain drugs may have enhanced bioavailability when administered as suspensions.
- **Reduced dosing frequency:** For drugs with a long half-life, suspensions can reduce the frequency of administration.
- **Visibility:** The visible particles can aid in application and monitoring.

Categories of Ophthalmic Suspensions

- **Eye drops:** These are the most common type of ophthalmic suspension, applied directly to the eye with a dropper.
- **Eye ointments:** These are thicker suspensions that are applied to the eye with a finger.

5. Rectal Drug Suspensions

Rectal suspensions are pharmaceutical preparations designed for administration intothe rectum. They consist of finely divided insoluble particles dispersed in a liquid medium. These suspensions offer several advantages over other rectal formulations:

Benefits of Rectal Suspensions

- **Absorption:** Rectal administration can provide systemic absorption of certain drugs, bypassing the gastrointestinal tract.
- **Local effects:** For conditions affecting the rectum or colon, suspensions can provide localized therapy.
- **Avoidance of first-pass metabolism:** Some drugs may avoid first-pass metabolism in the liver, leading to increased bioavailability.
- **Emergency use:** Rectal suspensions can be used in emergencies when oral or intravenous administration is not possible.

Categories of Rectal Suspensions

Suppositories: These are solid forms of suspensions that melt at body temperature, releasing the active ingredient.

Enemas: These are liquid suspensions that are administered into the rectum using a syringe or enema bag.

6. Pulmonary Suspension Systems

Inhalation suspensions are pharmaceutical preparations designed for inhalation into the lungs. They consist of finely divided insoluble particles dispersed in a liquid or gaseous medium. These suspensions offer several advantages over other inhalation formulations:

Benefits of Inhalation Suspensions

Direct delivery: Inhalation allows for direct delivery of the drug to the respiratory tract, bypassing systemic circulation.

Rapid onset of action: Drugs delivered by inhalation can have a rapid onset of action.

Reduced systemic side effects: By targeting the respiratory tract, inhalation can minimize systemic side effects.

Improved efficacy: For respiratory conditions, inhalation suspensions can be more effective than oral or parenteral administration.

Categories of Inhalation Suspensions

Aerosols: These are pressurized containers that deliver the suspension as a fine mist when activated.

Nebulizers: These devices convert the suspension into a fine mist using ultrasonic or air-jet technology.

Dry powder inhalers (DPIs): These devices deliver the suspension as a dry powder, which is inhaled through a mouthpiece.

7. Injectable Drug Suspensions

Injectable suspensions are pharmaceutical preparations designed for injection into the body. They consist of finely divided insoluble particles dispersed in a liquid medium. These suspensions offer several advantages over other parenteral formulations:

Benefits of Injectable Suspensions

- **Controlled release:** Suspensions can provide a controlled release of the active ingredient, ensuring prolonged action.
- **Improved bioavailability:** Certain drugs may have enhanced bioavailability when administered as suspensions.
- **Reduced dosing frequency:** For drugs with a long half-life, suspensions can reduce the frequency of injections.
- **Depot effect:** Some suspensions can create a depot effect, releasing the drug gradually over time.

Categories of Injectable Suspensions

- **Intramuscular suspensions:** These are commonly used for intramuscular injection.
- **Subcutaneous suspensions:** These are injected into the subcutaneous tissue.
- **Intravenous suspensions:** These are less common but can be used for certain drugs, such as certain vaccines.

Strategies for Suspension Development

Structured vehicle

In order to keep the solid particles deflocculated, physically stabilized suspensions are prepared using structured vehicles. Applying the flocculation principle results in a minimal amount of floccules that are easily re- dispersed. Non-flocculating particles are trapped by structured vehicles, preventing particle settling. Additionally, whenever shear is applied, the vehicles' shear thinning property makes it easier for a uniform dispersal to form. The product needs to flow easily out of the container and maintain a consistent particle distribution throughout each dosage [5].

Behavior ralrheology

Flocculated suspension, which is dependent on the concentration of solid particles, exhibits plastic or pseudoplastic flow. The viscosity of flocculated suspension is high when the applied shear stress is low. The concentrated deflocculated suspensions display the dilatant flow. Rheological considerations are useful for examining how viscosity influences the dispersion and settling of solid particles. Every time a suspension is shaken, its flow characteristics change [6].

Concepts Related to Dispersed Phase

The phenomenon of interfacial

In continuous media, very tiny solid particles are employed. Larger surface area and smaller particle sizes are associated with a It is thermodynamically unstable due to its surface free energy [7]. Floccules are the result of high energy particles grouping together. It is significantly influenced by weak van der wall forces. In other situations, particles that are strongly bonded together aggregate to create a hard cake. By lowering interfacial tension through the addition of surface active agents, the system tends to decrease particle surface free energy in order to produce a high stable product [8].

Zeta potential and the double layer of electricity

The potential between the surface of the close boundary layer and the electron-neutral region of the solution is referred to as the zeta potential, or the plane of shear. The majority of surfaces acquire a charge, which is known as electrical surface charge. A charged solid surface that comes into contact with water produces two opposing poles: one that is negatively charged and the other that is positively charged [9]. In suspension stability involving solid dispersion, the Zeta potential serves a useful purpose. Zeta potential is useful for maintaining the stability of a suspension with solid particles dispersed throughout it.

DLVO (Derjaguin Landau and Overbeek) Theory

This theory states that the sum of electrical repulsion forces and van der Walls attraction is the total potential energy of interaction that participate in a distributed system.

Development of Pharmaceutical Suspensions

Structured vehicles

For the preparation of stable pharmaceutical suspensions, the selection of an appropriate structured vehicle is highly important. Suspensions often face physical stability problems during prolonged storage, particularly sedimentation and cake formation. To minimize these issues, thickening agents or structured vehicles are incorporated into the formulation. These vehicles provide a false-body characteristic that helps keep particles uniformly dispersed and improves suspension stability [10]. Structured vehicles are especially beneficial in deflocculated suspensions, where particles tend to settle and form hard cakes that must be easily redispersed before use. However, they are generally unsuitable for flocculated suspensions because such systems redisperse readily after shaking. In parenteral suspensions, structured vehicles are used cautiously since increased viscosity may create

problems during syringe administration [11]. Additionally, the structure vehicle has some thixotropic characteristics, such as the GEL-SOL-GEL transformation. Saturated vehicle preparation: Hydrocolloids in a given medium first hydrolyze, swell to a degree of two, and then increase viscosity at lower concentrations. Glycerin and polyethylene glycol also raised the density of the structured vehicle [12].

Suspending agent

Compounds known as suspending agents reduce the attraction between solid particles by forming a film around them. Other functions of some suspending agents include giving the solution viscosity. The solution must be sufficiently viscous at resting conditions to avoid particle sedimentation and cake formation [13]. Suspension agents with a thixotropic characteristic are better. For instance, Avicel RC591, sodium carboxymethyl cellulose, xanthan gum, etc. PEG (Polyethylene Glycol) 3350, PEG 4000, and other suspending density modifying agents are used in parenteral suspensions. PEGs with molecular weights between roughly 300 and 6000 g/mol are appropriate for use as parenteral suspending agents. The presence of additional substances that could contribute to viscosity determines how much of the suspending agent is needed [14].

Methyl cellulose

There are numerous varieties of methyl cellulose viscosity grades available. These discrepancies are caused by variations in polymer chain length and methylation. It dissolves in both hot and cold temperatures. With constant stirring, a transparent, opalescent viscous solution is created when methyl cellulose is added to hot water and cooled. In the pH range of 3 to 11, it remains stable. The solution becomes gel at temperatures higher than 500°C. It turns into a solution when it cools down. Methyl cellulose is nontoxic and not absorbed by the digestive system [15].

Hydroxyethyl cellulose

comparable qualities. Like methyl cellulose, HEC does not gel when heated, but it is soluble in Like methyl cellulose, hydroxyethyl cellulose (HEC) is a potent suspending agent with both hot and cold water. [16]

Carboxymethyl cellulose

Carboxymethyl cellulose comes in low, medium, and high viscosity grades and is utilized in a variety of applications. The choice stability and viscosity of the suspension determine the appropriate CMC grade [17].

Sodium carboxymethyl cellulose

The degree of polymerization determines the amount of sodium carboxymethyl cellulose. It comes in a range of viscosities. It is stable in the pH range of 5 to 10 and soluble in both hot and cold water. Polyvalent cations are incompatible with it [18].

Tragacanth

Tragacanth is viscous by nature. The solution becomes a thixotropic solution as a result. It works better than acacia as a thickening agent. Since it takes several days for the solution to fully hydrate, the maximum viscosity is reached after a few days [19].

Xanthan Gum

The active pharmaceutical ingredient determines the xanthan gum concentration. The concentration of xanthan ranges from 0.08% w/w to 0.12% w/w. The paracetamol suspension has a concentration of 0.1% w/w to 0.3% w/w.

Wetting agents

Wetting agents are substances that lower the surface of water. tension that enhances the ability of liquids to spread and disperse drops onto the surface. Water quickly hydrates hydrophilic surfaces, but non-polar liquids hydrate hydrophobic substances. The hydrophilicity of the material determines how well it wets. A high interfacial tension between the liquid and particles is indicated by wetting inability [20]. Since ionic surfactants are incompatible with certain adjuvants and alter pH, nonionic surface-active agents are utilized in the manufacturing of pharmaceutical suspensions. Their HLB value ranges from 7 to 10. It functions as a forming agent if the HLB value is high [21]. By lowering surface tension, wetting agents

disperse droplets onto the surface. Surface active agents Certain compounds known as surface active agents lessen the interfacial tension between solid particles. Although ionic surfactants are frequently utilized, nonionic surface- active chemicals are frequently utilized based on certain circumstances. All surfactants, with the exception of pluronics and poloxamers, usually have a bitter taste. Polysorbate 80, a surfactant, is frequently used in oral and parental formulation. Polysorbate 80 is widely used since it is non-ionic, meaning its pH does not vary, non-toxic, compatible with adjuvants, and safe for oral usage [22]

pH Adjusting Agents

Buffering agents are substances that are resistant to pH variations. All liquid formulations should be made at an ideal pH for stability's sake. The system's pH also affects other characteristics like viscosity and rheology. Ionizable acidic or basic groups that are stable between pH 4 and pH 10 make up the formulation in which the API is used. [23].

Antimicrobial Preserving Agents

Preservatives in suspensions include naturally occurring substances such as acacia, tragacanth, etc. are rapidly broken down by microorganisms. If the suspensions are not properly preserved, the microbes lead to stability issues, which include a decrease in the suspending agents' ability to suspend as well as a loss of color, flavor, and odor. The formulation contains preservatives to stop these activities. The substances that stop the formulation from growing microbiologically are known as preservatives. The ideal preservatives are nontoxic, insensitive to pH, insoluble in the container's surface, and compatible with other excipients [24]. Airtight glass containers are intended to maintain the preservatives' effectiveness. The preservative adhering to the plastic container's surface is the most frequent problem with plastic containers [25]. When two or more preservatives are combined, the formulation benefits more because they are less toxic, have a wider range of activity, and require less concentration. For instance, eye drops now contain a mixture of phenylethyl alcohol, benzalkonium chloride, and phenoxetol. Among the preservatives are methyl paraben, potassium sorbate, propylene glycol, cetrimide, disodium edetate, benzoic acid, and sorbic acid. [26].

Osmotic

Osmotic agents Osmotic agents are used to maintain the osmotic pressure when making parenteral and ophthalmic suspensions. In ophthalmic preparations, dextrose, sorbitol, and mannitol are typically employed as osmotic agents. Glycerol, sodium chloride, and sodium sulfate are examples of regulating agents used in parenteral tonicity [27].

Taste Enhancing Agents

Flavoring agents are substances that give a medication a taste and improve a patient's acceptance of it. The purpose of flavoring and coloring agents is to enhance the drug's taste and appearance while also masking its unpleasantness. Each country has a different color and flavor. Acacia, ginger, anise oil, glucose, benzaldehyde, glycerin, tolu balsam, honey, vanilla, vanilla tincture, lemon oil, clove oil, orange oil, rose oil, fennel oil, coriander oil, and so on are varieties of flavoring agents. [28].

Moisture Retaining Agents

Humectants are substances that absorb moisture and aid in preventing the active pharmaceutical ingredient from being affected by moisture. The most widely used humectants are propylene glycol and glycol, which are used at a concentration of 4% w/w [29].

Oxidation Preventing Agents

Antioxidants: These substances keep drugs from oxidizing and improve formulation stability. Examples include derivatives of ascorbic acid, tocopherol, and thiols such as thioglycerol and cysteine.

Colouring Components

The compounds known as coloring agents are what give the formulation its color. They come from both natural and artificial sources. Plants, animals, and minerals are the sources of natural colors; the pigments that give minerals their color are called natural colors. The range in which the synthetic dyes should be used is 0.0005 percent to 0.001 percent.

Examples of coloring agents include caramel (brown), tetrazine (yellow), indigo carmine (blue), titanium dioxide white, and so forth. [30].

Quality Control During Manufacturing of Suspensions

The manufacturer uses quality control procedures to guarantee and monitor the final product's quality as well as to address any existing defects.To guarantee consistent output, production staff carry out and record quality control.

Goals of In-Process Quality Control

In order to avoid intra-batch and inter-batch variability. Verify if or not good manufacturing practices are being used. The final product quantity is guaranteed.

Tests Performed During Suspension Manufacturing

To guarantee the stability, safety, and quality of the products, quality control tests are conducted during the process. These are listed below: -

Phase test for appearance

Phase test for appearance: Both the dispersed phase and the dispersion medium are commonly used for appearance tests. The suspension is usually made with purified water. This test typically measures the water quality, gum dispersion consistency, solid particle distribution, and syrup purity. In order to formulate a stable and re-dispersible suspension, rheological tests are performed to ensure that the medium has the required viscosity. The viscositynof the dispersion medium is guaranteed prior to the dispersed phase being mixed. A tool used to measure the viscosity of suspension is the Brookefield viscometer. If a defect is discovered, the test results are compared to a standard reference, and appropriate action is taken [31].

Particle size of dispersed phase test

The stability of a drug's final product is greatly influenced by the size of its particles. The particles are analyzed size-microscopically to perform this test. Serious action is taken if there is a discrepancy between the medication's particle size and the ideal particle size required.

Pourability test

This test is used to determine whether the finished formulation is pourable and won't cause any issues when patients handle it or when it's being filled in a container.

pH Stability Test

pH test The stability of the formulation depends on its pH. Thus, before and after mixing, various vehicle types and suspension phases are monitored. To confirm that proper pH can be maintained, records are also kept up to date.

Final Product Assay Test

Whether or not the active ingredients are dispersed uniformly throughout the formulation is determined by the final product assay test. In order to determine the level of homogeneity, the sample is taken out and an assay is performed. By closely observing the formulation processes, aflaw is fixed if it is found.

Centrifugation test

The physical stability of the suspension is ascertained by a centrifugation test. Uniform color dispersion and the lack of air globules are checked prior to packaging.

Packaging of Pharmaceutical Suspensions

In particular, the packaging materials help make the suspension stable and acceptable. Nowadays, with the globalization of drug regulations and the increasing complexity of dosage types, pharmacists must be aware of the wide variety of packaging materials. To extend the suspension's shelf life, the industrial pharmacist should be aware of how the properties of the materials interact. Pharmaceutical suspensions are typically packaged in wide-mouth containers with a gap to allow for adequate mixing during shaking. Parenteral suspensions are packaged in glass ampoules or vials. Packaging should ideally be made of inert material. Protecting the product from air, light, and other elements should work well. In order

to transport the product without any problems, it should be inexpensive and efficient [33].

Packaging Materials Used: -

Plastics

Typically, suspension packaging is composed of different grades of plastic and glass. Nowadays, plastic is frequently used for packaging instead of glass because it has so many benefits. Plastic is lightweight, flexible, and non-breakable. Plastic packaging is made of materials like polysorbate, PVC, and polyethylene. Leaching, permeation, chemical reactions, sorption, and modifications to the physical properties of plastic are all factors that are taken into account when selecting plastic as a suspension packing material [34].

Glass

Glass Typically, borosilicate glass and sodalime are used to make non-parenteral suspensions. Glass containers with an amber hue are used to package the formulations that are deteriorated by light. Amber glass blocks the passage of UV light through the mixture. [35]

Important Labeling Instructions for Suspensions

The most crucial warning on the suspension's label is "shake well before use," since some medication sedimentation is typically expected. Shaking the container aids in the medication's redispersion and guarantees that patients are taking the recommended dosage. Temperature changes affect the stability of "store in cool place" instructions. A refrigerator can be used to store certain suspensions that are created by reconstituting dry powder. [36]

Recent Advancements in Suspensions: -

Polymer coating of drugs suspension

The polymer coating helps the patient taste the formulation by allowing them to swallow the drug particles before the threshold concentration enters their mouth. Among the polymers used for coating are ethyl cellulose, Eudragit RS 100, Eudragit RS 30 D, and a few others. This procedure is frequently used to prepare reconstitutable powders or dry powder medications that are just before use mixed in a liquid medium, such as water, to create a suspension. The shelf life of these reconstituted powders coated with polymers is long [37].

Encapsulation with basic substance

A bitter-tasting drug is combined with a basic substance in this process. This mixture is then encapsulated using polymers, such as vinyl and cellulose derivatives. (). The final product is now obtained by dispersing and suspending this encapsulated product in a suspending medium [38].

Coating and pH control

When using the pH control method, medications that dissolve at low pH levels are best kept in suspension at high pH values, where the drug particles become insoluble, and vice versa. By using polymeric coating, we can prevent the drug from becoming soluble and achieve taste masking [39].

Nano-Suspensions

Nano-suspensions, which are delivered at a size of less than 50 nm, will increase the potency of insoluble medications and reduce drug membrane permeability. In the process of creating I.V. suspension, the particle size should be less than 50 nm. The particles in suspension circulate for a long time without being filtered by the normal reticuloendothelial system. In the case of an oral delivery system, the active pharmaceutical ingredient may be delivered into the bloodstream by nanometer-sized molecules with minimal degradation in the gastrointestinal tract and at a high desired rate. This size of insoluble particles is designed to get through the barriers. Encapsulating the active medication is another tactic that uses nanoparticulate degradable polymer structures [40].

Benefits of Nano-Suspensions

- It helps in poorly water-soluble drugs.
- In case of intra-cutaneous and intramuscular administration it helps in reducing the tissue irritation.
- Quick resolution and quick targeting can be achieved through intravenous route.

- When we administer through oral route nano-suspensions provide rapid and better bioavailability.
- Due to presence of stabilizers long term stability can be

Limitations of Nano-Suspensions

- Difficulty in achieving uniform and accurate dose.
- Due to bulky nature that's why sufficient care must be taken for the handling and transportation.

Uses of Nano-Formulations

- Parenteral administration
- Parenteral route is preferred for those drugs which are not absorbed by GIT or undergoes first-pass metabolism. Parenteral route has very fast action and low quantity of drug is required from this route because of high bioavailability.
- Bioavailability enhancement
- The bioavailability of oral route is less because of low solubility in the GIT.
- Pulmonary administration
- Water soluble nanosuspensions can be directly delivered in lungs by the help of nebulizers. Due to small size of particles, it is likely that each drop must contain at least one particle of drug that leads to more uniform distribution of drugs in lungs.

Target-Specific Drug Delivery: -

It is mainly used for targeting antimicrobial and antifungal drugs.

Extended Release Suspensions: -

This technique extends the drug's duration of action without changing its onset. When it comes to suspension, the polymer coating of the drug formulation has an impact on sustained release. Polymer coating prolongs the duration of action and helps conceal bitter medications. Its primary benefit was a decrease in the frequency of doses. The polymers ethyl cellulose, eudragit, cellulose acetate, and others are examples of the polymers used in the sustained release suspension. Microparticles and other multi-unit formulations are more advantageous than single-unit formulations in the development of novel drug delivery. It is also possible to formulate multi-unit formulations as liquid suspensions, which enable elderly and pediatric patients to have their swallowing and flexibility adjusted.

Benefits of Sustained Release Suspensions

- Improve patient's compliance by reducing frequency of dosing.
- They are economically fit.
- It enables increased reliability of therapy
- Efficacy improved

Drug Release Mechanism from Matrix Systems

Dissolution controlled release

Making a sustained release oral product with dissolution as the time limiter is the easiest. Using a carrier, it is possible to change a tablet with a high dissolution rate into one with a low dissolution rate.

SUMMARY: -

Polymer coating suspension, nanosuspension, encapsulation with basic compounds, and other recent developments in pharmaceutical suspension are examples. assisted in getting around traditional suspension's drawbacks. Drug release, dissolution time, membrane permeability, bioavailability, and drug disposition were all improved by this development, which also enhanced the physiochemical constraints of conventional suspension. In order to overcome the limitations and improve patient compatibility, extensive research has been done on creating new dosage formulations and refining current dosage forms. Suspensions have long been a useful dosage form, and new research indicates their potential for target treatment therapeutics, patient compatibility, and efficacy.

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