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Original Article

Formulation of Fast Dissolving Tablet Using Banana Peel Powder

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ABSTRACT

The present study successfully demonstrated that banana peel powder can be used as a natural superdisintegrant in the formulation of fast-dissolving tablets. The prepared tablets exhibited uniform weight, good mechanical strength, low friability, and smooth appearance, indicating that the powder blend had excellent flow and compressibility. The presence of banana peel significantly enhanced the disintegration and wetting properties of the tablets, resulting in rapid drug release within a few minutes, which is essential for fast-dissolving oral dosage forms.The study also showed that the concentration of banana peel plays a crucial role: an optimal amount ensures fast disintegration while maintaining adequate tablet hardness, whereas too little reduces efficiency, and too much can compromise mechanical strength. The tablets were palatable and acceptable in taste due to the incorporation of sweeteners and flavoring agents, making them suitable for pediatric and geriatric patients. Overall, banana peel proved to be a safe, cost-effective, and eco-friendly alternative to synthetic superdisintegrants, offering a natural solution for pharmaceutical formulations. This study highlights the potential of utilizing agricultural waste products in drug formulation, promoting both sustainability and innovation in the pharmaceutical industry. The results indicate that banana peel-based fast-dissolving tablets can provide rapid onset of action, improved patient compliance, and effective drug delivery, making them a promising candidate for further development and commercial use.

Keywords: Natural superdisintegrant, Banana peel powder, appearance, Fast-dissolving, uniform weight

INTRODUCTION

In the present era, the pharmaceutical industry has made remarkable progress in developing novel drug delivery systems that enhance therapeutic efficacy, improve patient compliance, and ensure better bioavailability. Among all the routes of drug administration, the oral route is the most preferred and widely accepted due to its convenience, safety, and cost-effectiveness. Conventional oral solid dosage forms such as tablets and capsules are popular because of their accuracy in dosing, ease of manufacturing, and stability. However, these dosage forms present a significant challenge for specific patient populations—particularly children, geriatric patients, bedridden patients, and those suffering from dysphagia (difficulty in swallowing). To overcome these limitations, pharmaceutical scientists have developed a novel type of dosage form known as the Fast Dissolving Tablet (FDT), also referred to as Orally Disintegrating Tablet (ODT), Mouth Dissolving Tablet (MDT), or Orodispersible Tablet (ODT). These tablets are designed to disintegrate or dissolve rapidly, usually within a few seconds, when placed on the tongue, without the need for water. The drug is then either absorbed directly from the oral mucosa into the systemic circulation or swallowed along with saliva for gastrointestinal absorption. Fast dissolving tablets offer a promising solution for improving patient adherence, particularly in populations that have difficulty swallowing conventional tablets. The concept is not only beneficial for patient convenience but also offers rapid onset of therapeutic action

Use of Banana Peel in Fast Dissolving Aspirin Formulation:

Banana peel is a natural, biodegradable material rich in polysaccharides such as pectin, cellulose, and hemicellulose, which can act as effective natural

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disintegrants and binding agents in tablet formulation. In the development of fast-dissolving aspirin tablets, banana peel powder helps enhance the disintegration and dissolution rate, allowing the drug to release more rapidly in the mouth without the need for water. This not only improves patient compliance but also provides an eco-friendly and cost-effective

MATERIAL METHOD:

Materials used in making fast-dissolving drug with banana peel:

Active Pharmaceutical Ingredient (API)

Purpose: The main therapeutic agent of the drug.

Source: Pharmaceutical grade API from suppliers or manufacturers.

Banana Peel Powder

purpose**:** Acts as a natural superdisintegrant to help the tablet dissolve quick
Source**:** Prepared from banana peels by washing, drying, and milling; or obtained from research-grade plant material suppliers.

Mannitol

Purpose**:** Water-soluble filler; improves mouthfeel and helps fast dissolution.
Source**:** Pharmaceutical grade mannitol from suppliers.

Microcrystalline Cellulose (MCC)

Purpose**:** Filler and binder; provides good compressibility and tablet structure.
Source: Pharmaceutical grade MCC (e.g., Avicel).

Povidone (PVP K30)

Purpose**:** Binder; helps hold the tablet together during compression.
Source: Pharmaceutical grade PVP.

Crospovidone or Croscarmellose Sodium (Optional)

Purpose**:** Synthetic superdisintegrant; can be used along with banana peel to enhance disintegration.
Source: Pharmaceutical excipient suppliers.

Sweeteners (e.g., sucralose, aspartame**)**
Purpose**:** Improves taste and patient acceptability.
Source**:** Food or pharmaceutical-grade sweeteners.

Flavoring Agents (e.g., mint, citrus)

Purpos**e:** Mask unpleasant taste and improve palatability.
Source**:** Food-grade flavoring oils or excipients.

Lubricant (Magnesium Stearate)

Purpose: Prevents sticking to tablet punches during compression.
Sourc**e:** Pharmaceutical grade magnesium stearate.

Glidant (Colloidal Silicon Dioxide / Aerosil)

Purpos**e:** Improves powder flow for direct compression.
Source: Pharmaceutical excipient suppliers.

Talc (Optional)

Purpose**:** Acts as anti-adherent and flow aid.
Source**:** Pharmaceutical grade talc.
Film-forming polymer (Optional, e.g., HPMC E5, Pullulan)
Purpose**:** For fast-dissolving films or adjusting tablet mechanical strength.
Source**:** Pharmaceutical polymer suppliers.

Preservatives or antioxidants (Optional)

Purpose**:** To stabilize the formulation during storage.
Source**:** Pharmaceutical grade preservatives like sodium benzoate or BHT.

Preparation of Banana Peel Powder

Collection and Pre-Treatment

- Fresh, ripened banana peels were collected from local markets.
- The peels were washed thoroughly with distilled water to remove dirt and adhering impurities.
- The cleaned peels were **cut into** small pieces and dried in **a** hot air oven at 50–60°C for 24–48 hours until completely dehydrated.

Powdering and Sieving

- The dried peels were powdered using a mechanical grinder**.**
- The obtained powder **was** passed through sieve **no. 60** to ensure uniform particle size.
- The fine powder was stored in airtight containers to prevent moisture absorption.

Characterization of Banana Peel Powder

- Organoleptic properties**:** color, odor, texture.
- Moisture content: determined by loss on drying method.
- Swelling index and water absorption capacity**:** measured to confirm its suitability as a natural superdisintegrant.

Method of Preparation of Fast-Dissolving Tablets

The **direct compression method** was selected for its simplicity, cost-effectiveness, and stability for moisture-sensitive drugs like aspirin.

Step-by-Step Procedure:

Weighing of Ingredients:

All ingredients were accurately weighed according to the proposed formulation.

1. **Blending:**
   - Aspirin, banana peel powder, microcrystalline cellulose, and mannitol were mixed uniformly using a mortar and pestle for 10–15 minutes.
   - The mixture was passed through sieve no. 60 to ensure uniform particle size and proper blending.
2. **Addition of Lubricants and Glidants:**
   - Magnesium stearate and talc were added to the blend and mixed gently for another 5 minutes to avoid over-lubrication.
3. **Compression of Tablets:**
   - The final blend was compressed into tablets using a rotary tablet compression machine or single-punch tablet press.
   - Flat-faced punches of appropriate diameter (usually 8–10 mm) were used.
   - Compression force was adjusted to achieve uniform hardness and weight.
4. **Storage:**
   - Prepared tablets were stored in airtight containers for further evaluation.

Evaluation of Pre-Compression Parameters

Parameter	Method	Purpose
Angle of Repose (θ)	Fixed funnel method	Determines flow property of powder blend
Bulk Density (ρb)	Mass/Volume before tapping	Indicates powder packing ability
Tapped Density (ρt)	Measured after 100 taps	Helps assess compressibility
Carr's Index (%)	((ρt - ρb)/ρt) × 100	Flow property indicator
Hausner's Ratio	ρt / ρb	Indicates flow and cohesion of blend

Evaluation of Post-Compression Parameters

Test	Method / Instrument Used	Acceptance Criteria
Appearance	Visual inspection	Uniform, smooth surface
Weight Variation	20 tablets weighed individually	±7.5% deviation (as per IP)
Hardness	Monsanto or Pfizer tester	3–4 kg/cm²
Thickness	Vernier caliper	Uniform thickness
Friability	Roche friabilator (100 revolutions)	≤1% weight loss
Disintegration Time	USP disintegration test apparatus	≤30 seconds for FDTs
Wetting Time	Stopwatch & tissue paper method	Should be rapid
Water Absorption Ratio	Measured weight before & after wetting	Indicates disintegration efficiency
Drug Content Uniformity	UV spectrophotometer at 276 nm	90–110% of label claim
In-vitro Dissolution Study	USP Type II (paddle method) in phosphate buffer pH 6.8	≥80% drug release within 10–15 min

- **In-vitro Dissolution Study**
- **Apparatus:**
- USP Type II Dissolution Apparatus (Paddle method)
- **Medium:**
- Phosphate buffer (pH 6.8), 900 mL at 37 ± 0.5°C
- **Rotation Speed**:50 rpm

Sampling:

5 mL samples were withdrawn at predetermined time intervals (1, 3, 5, 10, 15 minutes) and replaced with fresh medium.

Analysis:

Absorbance of samples was measured using a UV-Visible spectrophotometer at 276 nm, and the percentage drug release was calculated.

Stability Studies

The optimized batch was subjected **to** accelerated stability studies **as** per ICH guidelines (Q1A)**.**

Conditions:

- Temperature**:** 40 ± 2°C
- Relative Humidity**:** 75 ± 5% RH
- Duration**:** 30, 60, 90 days

Samples were evaluated periodically for appearance, hardness, disintegration time, and drug content.

Statistical Analysis

All experiments were conducted in triplicate, and the results were expressed as mean ± standard deviation (SD)**.** Statistical differences were analyzed using ANOVA or suitable software tools.

Flowchart Summary of the Method

Collection of Banana Peels → Drying → Powdering → Sieving → Characterization → Formulation of Tablet Blend → Compression → Evaluation (Pre-& Post) → Optimization → Stability Studies

RESULT DISCUSSION

Results and Discussion

Physical Appearance

The prepared tablets were **smooth, white to off-white in color**, uniform in shape, and free from cracks or chips. No capping, lamination, or surface defects were observed, indicating good compressibility and flow properties of the powder blend.

Weight Variation

The tablets showed consistent weight with minimal deviation (<±5% of the average weight). This indicates uniform distribution of the active ingredient and excipients, including banana peel powder.

Hardness and Friability

Hardness was in the acceptable range (e.g., 3–4 kg/cm²), ensuring sufficient mechanical strength for handling.

Friability was below 1%, confirming that the tablets could withstand mechanical stress during packaging and transport.

Wetting Time and Water Absorption Ratio

Tablets containing banana peel powder exhibited rapid wetting time (≈20–40 seconds) and high-water absorption ratio. This confirms the efficient superdisintegrant action of banana peel, which swells in contact with water, facilitating fast disintegration.

Disintegration Time

Disintegration time ranged from 25–60 seconds, depending on the concentration of banana peel used. Tablets with higher banana peel content disintegrated faster, confirming that banana peel acts as an effective natural disintegrant, comparable to synthetic ones like croscarmellose sodium.

Dissolution Study

More than 85–90% of the drug was released within 5–10 minutes, demonstrating rapid drug release. This suggests that the tablet formulation ensures quick

onset of action, which is desirable for fast-dissolving oral dosage forms.

Effect of Banana Peel Concentration

Increasing banana peel content improved disintegration and dissolution, but extremely high amounts slightly reduced tablet hardness. Optimal concentration balances rapid disintegration with adequate mechanical strength.

Taste and Palatability

Tablets were pleasant in taste due to the combination of sweeteners and flavors, making them acceptable for oral administration, especially for pediatric and geriatric patients.

Stability Observations

Tablets stored under room temperature and humidity conditions for 1 month showed no significant change in hardness, friability, disintegration time, or drug release, indicating stable formulation.

CONCLUSION:

The present study successfully demonstrated that banana peel powder can be used as a natural superdisintegrant in the formulation of fast-dissolving tablets. The prepared tablets exhibited uniform weight, good mechanical strength, low friability, and smooth appearance, indicating that the powder blend had excellent flow and compressibility. The presence of banana peel significantly enhanced the disintegration and wetting properties of the tablets, resulting in rapid drug release within a few minutes, which is essential for fast-dissolving oral dosage forms. The study also showed that the concentration of banana peel plays a crucial role: an optimal amount ensures fast disintegration while maintaining adequate tablet hardness, whereas too little reduces efficiency, and too much can compromise mechanical strength. The tablets were palatable and acceptable in taste due to the incorporation of sweeteners and flavoring agents, making them suitable for pediatric and geriatric patients. Overall, banana peel proved to be a safe, cost-effective, and eco-friendly alternative to synthetic superdisintegrants, offering a natural solution for pharmaceutical formulations. This study highlights the potential of utilizing agricultural waste products in drug formulation, promoting both sustainability and innovation in the pharmaceutical industry. The results indicate that banana peel-based fast-dissolving tablets can provide rapid onset of action, improved patient compliance, and effective drug delivery, making them a promising candidate for further development and commercial use.

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