



# REVIEW OF Banana Powder as Natural Super Disintegrants.

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## ABSTRACT

Excipients play a crucial role in pharmaceutical formulations beyond Active Pharmaceutical Ingredients (APIs), aiding in drug delivery, stability, and overall effectiveness. Natural excipients, derived from renewable sources, offer biocompatibility, biodegradability, and reduced toxicity, making them attractive alternatives to synthetic counterparts. Superdisintegrants are specialized disintegrating agents used in tablet and capsule formulations to facilitate the rapid breakdown of the dosage form upon contact with fluids, ensuring faster drug release and absorption. Among these, banana powder has gained interest as a potential natural excipient due to its binding, disintegrating, and stabilizing properties. While bananas are widely consumed as food, their pharmaceutical applications remain underexplored. This review aims to assess the feasibility of banana powder as a multifunctional excipient in various dosage forms, highlighting its physicochemical properties, formulation advantages, and potential industrial applications.

**KEYWORDS:** Banana powder, Excipient, Natural Super disintegrants.

## INTRODUCTION

### 1. Excipients <sup>1</sup>:

Excipients are vital components in pharmaceutical formulations, playing a crucial role in enhancing drug stability, bioavailability, and patient adherence. They serve multiple functions, including binding, disintegration, lubrication, and stabilization, to facilitate the efficient delivery of Active Pharmaceutical Ingredients (APIs). While synthetic excipients have been widely used, concerns regarding their safety, biocompatibility, and environmental impact have led to an increasing demand for natural alternatives.

## SOURCES OF EXCIPIENTS:

### 1. Natural Excipients

Derived from natural sources, these excipients are further categorized based on their origin:

- **Animal-Based Excipients:**

- *Lactose*: A sugar derived from cow's milk, commonly used as a filler or binder in tablets and capsules.
- *Gelatin* <sup>2</sup>: Obtained from animal skin, bones, and tissues (often from pigs or cattle), gelatin is primarily used for gel capsules and as a stabilizer in vaccines.

- **Plant-Based Excipients:**

- *Starches*: Sourced from plants like maize or potatoes, starches act as binders and disintegrants in tablet formulations.

- *Cellulose Derivatives*: Extracted from plant cell walls, compounds like microcrystalline cellulose are utilized as fillers and binders.
- *Natural Gums*<sup>2</sup>: Substances such as acacia and guar gum serve as binders and thickening agents.
- **Mineral-Based Excipients**:
  - *Talc*: A mineral used as a glidant and anti-caking agent.
  - *Calcium Phosphate*: Serves as a filler and binder in various formulations.<sup>2</sup>

## 2. Semi-Synthetic Excipients

These are chemically modified natural substances designed to enhance specific properties:

- Cellulose Derivatives:
  - *Methylcellulose*: Used as a thickening agent, emulsifier, and in controlled-release formulations.
  - *Carboxymethylcellulose (CMC)*: Functions as a stabilizer and viscosity enhancer.
- Modified Starches:
  - *Pregelatinized Starch*: Acts as a binder and disintegrant in tablet formulations.

## 3. Synthetic Excipients

Entirely man-made, these excipients are tailored for specific functionalities:

- Polymers:
  - *Polyvinylpyrrolidone (PVP)*: Serves as a binder and stabilizer in tablet formulations.
  - *Polyethylene Glycols (PEGs)*: Used as solvents, plasticizers, and in ointment bases.
- Surfactants:
  - *Polysorbates (e.g., Tween 80)*: Function as emulsifiers and solubilizing agents.
  - *Sodium Lauryl Sulfate*: Employed as a wetting and emulsifying agent.

## 2. Natural Super Disintegrants

Natural super disintegrants are substances derived from natural sources that are incorporated into pharmaceutical formulations to facilitate the rapid disintegration of tablets or capsules upon contact with moisture.<sup>3</sup> This rapid disintegration enhances the dissolution and absorption of the active pharmaceutical ingredient (API), leading to improved bioavailability and therapeutic efficacy. The use of natural super disintegrants is gaining popularity due to their biodegradability, biocompatibility, non-toxicity, and cost-effectiveness.

### ADVANTAGES:<sup>3</sup>

1. **Biodegradability**<sup>3</sup> – Derived from natural sources, they are easily biodegradable and environmentally friendly.
2. **Biocompatibility & Non-toxicity** – Being naturally sourced, they are biocompatible and less likely to cause adverse reactions or toxicity.<sup>4</sup>
3. **Cost-effectiveness** – Easily available from plants and other natural sources, they reduce production costs compared to synthetic alternatives.<sup>5</sup>
4. **High Swelling Index** – Many natural disintegrants have excellent water absorption and swelling properties, leading to faster tablet disintegration.<sup>5</sup>
5. **Regulatory Acceptance** – Many natural excipients comply with pharmacopeial standards (e.g., USP, BP, IP) and are widely accepted in formulations.<sup>4</sup>
6. **Good Patient Compliance** – Natural disintegrants improve the organoleptic properties (taste, mouthfeel) of orally disintegrating tablets (ODTs) and fast-dissolving formulations.<sup>5</sup>
7. **Versatility** – Can be used across various dosage forms, including conventional tablets, fast-dissolving tablets (FDTs), and orally disintegrating films (ODFs).<sup>5</sup>

8. **Sustainable & Renewable** – Natural super disintegrants are sourced from plants and marine organisms, making them sustainable and reducing the environmental burden.<sup>5</sup>

## IDEAL SUPERDISINTEGRANT

An ideal super disintegrant used in tablet formulations should meet several critical criteria to ensure effective disintegration and optimal drug release.

The key selection criteria include:<sup>6</sup>

1. **Low Solubility:** The disintegrant should exhibit minimal solubility in water to ensure it facilitates disintegration without dissolving itself.
2. **Non-Gelling Behaviour:** It should not form a gel upon contact with water, as gel formation can impede the disintegration process.
3. **High Hydration Capacity:** The ability to absorb water rapidly is essential for swelling and promoting tablet disintegration.
4. **Good Flowability and Compressibility:** The disintegrant should possess excellent flow properties to ensure uniform distribution within the tablet blend and adequate compressibility to maintain tablet integrity.
5. **Non-Complexing Nature:** It should not interact chemically with the active pharmaceutical ingredients (APIs) or other excipients, as such interactions can affect the drug's stability and efficacy.
6. **Pleasant Mouthfeel:** Especially important for orally disintegrating tablets (ODTs), the disintegrant should not impart a gritty or unpleasant sensation in the mouth.
7. **Compatibility with Other Excipients:** The disintegrant should be chemically and physically compatible with other components in the formulation to ensure consistent tablet performance.

## BANANA POWDER AS A NATURAL SUPERDISINTEGRANT

Banana powder, derived from *Musa* spp. (*Musa acuminata* and *Musa balbisiana*), has gained attention not only for its nutritional benefits but also for its potential pharmaceutical applications. Rich in carbohydrates, dietary fiber, and essential minerals, banana powder contains natural polysaccharides, starch, and mucilage, which contribute to its functional properties. These components make it a promising natural super disintegrant in tablet and capsule formulations by enhancing disintegration and improving drug release.

Despite its advantageous properties, the use of banana powder as a pharmaceutical excipient remains underexplored. This review aims to assess its potential as a natural super disintegrant by evaluating its physicochemical characteristics, functional properties, and suitability for pharmaceutical formulations. Additionally, it will discuss the challenges and future prospects of its utilization, providing a comprehensive understanding of its role as an alternative to synthetic superdisintegrant.



Figure: Banana Powder obtained from Bananas belong to the genus *Musa* within the monocotyledonous family Musaceae (Zingiberales).

## METHOD TO PREPARE BANANA POWDER

Requirements:

Material	Quantity
Unripe bananas	500 g
Ethanol (optional)	100 mL
Distilled water	200 mL
Drying equipment	As required
Grinding equipment	As required
Sieve (60# mesh)	As required
Airtight container	As required

Procedure:<sup>7,8</sup>

## 1. Selection and Cleaning

- Select **fresh, unripe bananas** and wash thoroughly to remove dirt and contaminants.

## 2. Peeling and Pretreatment

- Remove the banana peels and **slice the pulp into uniform pieces**.
- To prevent microbial growth, immerse the slices in **ethanol (100 mL) for 5 minutes** (optional step).

## 3. Drying

- Spread the banana slices evenly in a **tray dryer** and dry at **50–60°C** until a **constant weight** is achieved, ensuring complete moisture removal.

## 4. Grinding

- Pulverize the dried banana slices using a **mixer grinder** to obtain a fine powder.

## 5. Sieving

- Pass the powder through a **60# mesh sieve** to achieve uniform particle size.

## 6. Storage

- Store the sieved banana powder in an **airtight container** to prevent moisture absorption and degradation.<sup>7</sup>

## Mechanism of Action:

Banana powder serves as an effective natural super disintegrant in tablet formulations, facilitating rapid tablet disintegration and enhancing drug release. Its mechanism of action primarily involves **capillary action (wicking)** and **swelling**, both of which contribute to the breakdown of tablets upon contact with aqueous environments.<sup>9</sup>

## 1. Capillary Action (Wicking):

When a tablet containing banana powder is introduced into an aqueous medium, the liquid penetrates the tablet's porous structure, replacing the air adsorbed on the particles. This process weakens the intermolecular bonds within the tablet matrix, leading to its disintegration into finer particles. The effectiveness of this mechanism depends on the hydrophilicity of the banana powder and the maintenance of a porous tablet structure, which facilitates water uptake and promotes disintegration.

## 2. Swelling:

Upon hydration, the starch components in banana powder swell, exerting an outward force that disrupts the integrity of the tablet matrix. This swelling action generates a hydrostatic pressure within the tablet, causing it to break apart. Tablets with lower porosity benefit more from this mechanism, as the swelling force is more effectively exerted, leading to efficient disintegration.

Studies have demonstrated that tablets formulated with banana powder exhibit rapid disintegration and enhanced drug release profiles. For instance, formulations containing 6% banana powder have shown comparable or superior disintegration times and dissolution rates to those using synthetic super disintegrants like croscarmellose sodium. This efficacy is attributed to the combined effects of capillary action and swelling inherent to banana powder.

In summary, the dual mechanisms of capillary action and swelling enable banana powder to function effectively as a natural super disintegrant, promoting rapid tablet disintegration and improving drug bioavailability.<sup>9,10</sup>

## APPLICATIONS

### 1. Use in Fast-Disintegrating Tablets (FDTs)

- **Application:** Banana powder is primarily used in the formulation of fast-disintegrating tablets (FDTs) due to its excellent swelling and wicking properties. It facilitates quick breakdown of the tablet in the mouth, which is ideal for patients who have difficulty swallowing tablets.<sup>8</sup>

### 2. Comparison with Synthetic Super disintegrants

- **Application:** Banana powder is compared with synthetic disintegrants like croscarmellose sodium and sodium starch glycolate to assess its effectiveness in enhancing tablet disintegration and drug release.<sup>7</sup>

### 4. Banana Powder in Combination with Other Natural Disintegrants

- **Application:** Banana powder is often combined with other natural disintegrants, like guar gum or cassava starch, to create a synergistic effect that improves the tablet's disintegration and dissolution properties.<sup>11</sup>

### 5. Cost-Effective and Sustainable Pharmaceutical Excipients

- **Application:** The sustainability and cost-effectiveness of banana powder make it a valuable alternative to synthetic excipients in pharmaceutical formulations. Its potential for large-scale production from agricultural waste adds to its economic benefits.<sup>12</sup>

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