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Mimosa pudica Mucilage as a Functional Polymer in Pharmaceutical Applications

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Abstract: *Mimosa pudica* mucilage has emerged as a versatile natural polymer with considerable potential for pharmaceutical applications due to its biocompatibility, biodegradability, and unique physicochemical properties. This study explores the extraction, characterization, and evaluation of *Mimosa pudica* mucilage, focusing on its use as a functional polymer in drug delivery systems. The mucilage was characterized for its organoleptic properties, swelling index, solubility, flow properties, and ash content. Results indicate that *Mimosa pudica* mucilage exhibits good swelling and gelling properties, making it ideal for use as a binder, disintegrant, and controlled-release agent in pharmaceutical formulations. Its high purity, as reflected by low ash values, and favorable flow properties further enhance its suitability for solid dosage forms. The findings of this study suggest that *Mimosa pudica* mucilage can serve as a promising alternative to synthetic polymers, offering advantages in terms of safety, cost, and environmental sustainability.
Keywords: *Mimosa pudica*, mucilage, natural polymer, drug delivery, swelling index, pharmaceutical excipient

Introduction

The exploration of natural polymers in pharmaceutical formulations has gained considerable momentum in recent years due to their inherent advantages such as biocompatibility, biodegradability, and eco-friendliness (Rizvi et. al., 2022, Sepulveda et. al., 2007). Among these natural polymers, mucilage, a plant-derived hydrocolloid, has emerged as a versatile material with applications ranging from drug delivery systems to food technology (Cunha et. al., 2009). In particular, *Mimosa pudica*, commonly known as the "touch-me-not" plant, is rich in mucilage, which has unique physicochemical and functional properties that make it a promising candidate for pharmaceutical applications (Das et.al., 2007, Prasad et.al., 2019). *Mimosa pudica* mucilage, composed primarily of polysaccharides, exhibits excellent swelling, gel-forming, and adhesive properties, making it ideal for use as a binder, disintegrant, suspending agent, and controlled-release polymer in various dosage forms (Liu et.al., 2017, Prabhanjan et.al., 2014). Its natural origin and non-toxic profile provide an alternative to synthetic polymers, which often raise concerns regarding safety, environmental impact, and cost (Stork et al., 1997, Aulton et al., 1988). Furthermore, the extraction of *Mimosa pudic*a mucilage is relatively simple, sustainable, and economically viable, especially in regions where the plant is abundantly available (Estruch et.al., 1996).

The potential applications of *Mimosa pudica* mucilage in the pharmaceutical field are vast. Its gelling and swelling properties can be utilized to modulate drug release in oral dosage forms, ensuring prolonged therapeutic effects and improved patient compliance (Prasad et.al., 2019, uLiu et.al., 2017). As a bioadhesive, it can facilitate targeted drug delivery, particularly in mucosal tissues, enhancing the efficacy of drugs with poor bioavailability. Additionally, its emulsifying properties may contribute to the stabilization of formulations such as emulsions and suspensions, further broadening its utility in drug development (Das et.al., 2007, Grochulski et.al., 1995). Several studies have begun to explore the physicochemical characteristics of *Mimosa pudica* mucilage, including its viscosity, thermal stability, and rheological behavior, all of which are critical parameters for its functionality in

pharmaceutical applications. However, comprehensive research on its integration into modern drug delivery systems remains limited. This paper aims to address this gap by providing a detailed evaluation of *Mimosa pudica* mucilage as a functional polymer, focusing on its role in enhancing drug delivery, formulation stability, and overall therapeutic efficacy (Cunha et. al., 2009, Grochulski et.al., 1995).

By investigating the structural composition, extraction methods, and pharmacotechnical applications of *Mimosa pudica* mucilage, this study seeks to contribute to the growing body of knowledge on plant-derived polymers. Additionally, it highlights the potential advantages of *Mimosa pudica* mucilage over conventional synthetic polymers, such as improved patient safety, environmental sustainability, and cost-effectiveness (Rizvi et. al., 2022, Aulton et al., 1988). The findings presented in this paper aim to lay the foundation for future research into the use of *Mimosa pudica* mucilage as a multifunctional excipient in pharmaceutical science.

Materials and methods

Collection and Authentication of Plant Material

The aerial parts of *Mimosa pudica* were collected from Pune, Maharashtra, India, during the monsoon season when the plant is in full vegetative growth. The plant material was authenticated by the BSI (Authentication No. BSI/WRC/MPM/2024/H2). Voucher specimens were deposited for future reference. All chemicals and reagents used in the study were of analytical grade, sourced from Sigma-Aldrich and other certified suppliers.

Extraction of Mucilage

The freshly collected plant material was washed thoroughly with distilled water to remove any dirt and impurities. The leaves and stems were cut into small pieces and soaked in distilled water for 24 hours at room temperature to release the mucilage. The soaked material was then boiled for 30 minutes to enhance mucilage extraction. The resulting solution was filtered through muslin cloth to separate the fibrous material from the mucilage-containing liquid. The filtrate was precipitated using an equal volume of ethanol (95%) to isolate the mucilage. The precipitated mucilage was separated by centrifugation at 5000 rpm for 15 minutes. The mucilage was then washed repeatedly with ethanol to remove any residual impurities and was dried in a hot air oven at 40°C. The dried mucilage was pulverized into a fine powder and stored in airtight containers for further analysis. (El-Desouky et.al., 2021)

Characterization of Mucilage

The physicochemical properties of the isolated mucilage were evaluated. The moisture content, ash value, and pH were determined using standard Pharmacopeial methods. Solubility tests were performed in water, ethanol, and acetone to assess the solubility profile of the mucilage. The viscosity of the mucilage was measured using a Brookfield viscometer at varying concentrations (0.5% to 2% w/v) and temperatures (25°C and 37°C).

Phytochemical Screening

Preliminary phytochemical screening of the isolated mucilage was conducted to detect the presence of carbohydrates, proteins, alkaloids, flavonoids, tannins, and saponins using qualitative tests. The total carbohydrate content was quantified using the phenol-sulfuric acid method.

Table 1 *Taxonomical Classification*

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Genus	*Mimosa*
Species	*Mimosa pudica* L.

Physicochemical Evaluation of *Mimosa pudica* Mucilage

The isolated mucilage from *Mimosa pudica* was evaluated for a variety of physicochemical properties to determine its suitability as a natural polymer in pharmaceutical applications.

Organoleptic Properties of Mucilage

The isolated *Mimosa pudica* mucilage was characterized for organoleptic properties including its color, taste, odor, and texture. It appeared as a light brownish powder, was odorless, and exhibited a smooth, mucilaginous texture.

Phytochemical Properties of Mucilage

Preliminary phytochemical tests were conducted to confirm the nature of the isolated mucilage. Various chemical tests such as Molisch's test for carbohydrates and others for the presence of alkaloids, steroids, glycosides, tannins, and saponins were performed to evaluate its chemical profile (Sepulveda et. al., 2007). The mucilage tested positive for carbohydrates and mucilage, while tests for alkaloids, steroids, glycosides, tannins, proteins, and saponins were negative.

Flow Properties

The flow properties of *Mimosa pudica* mucilage, including the angle of repose, bulk density, compressibility index, and Hausner's ratio, were evaluated to assess its applicability in solid dosage forms. These parameters were measured following procedures outlined in official pharmacopeial books (Aulton et al., 1988).

Result and discussion

The mucilage was isolated from the stems of *Mimosa pudica* with a percentage yield of 13%. The yield was calculated by weighing the dried, isolated mucilage and applying the formula:

Yield (%) = Weight of isolated mucilage powder (gm) Weight of seed (gm) ×100

Table 2 *Physicochemical Characteristics of* Mimosa pudica *Mucilage*

Sr. No	Tests	Observation
1	Description	Light brownish
2	Solubility	Soluble in water, insoluble in organic solvent
3	Odour	Odourless
4	Appearance	Smooth, Mucilaginous
5	Melting range	Decomposes above 180^0 C
6	pH	6 to 7
7	Loss on drying	8.5 %
8	Ash value	5.8 %
9	Acid insoluble Value	0.4%
10	Swelling index	85% in water, 70% in HCl, 60% in phosphate buffer
11	Test for Carbohydrate (Mollish test)	+Ve
12	Alkaloids	-Ve
13	Steroids	-Ve
14	Glycosides	-Ve
15	Tannins	-Ve
16	Proteins	-Ve
17	Saponins	-Ve
18	Mucilage	+Ve
19	Test for foreign matter	NMT 0.1%

The mucilage of *Mimosa pudica* was evaluated for its physicochemical characteristics, revealing several promising features for pharmaceutical applications. It appears whitish, is soluble in water but insoluble in organic solvents, and is odorless with a smooth, mucilaginous texture. These attributes are advantageous for excipients, where solubility and sensory neutrality are critical. The mucilage decomposes above 150°C, suggesting stability at lower processing temperatures. It exhibits a mildly

acidic pH of 5.5–6, making it suitable for formulations that require compatibility with biological systems. Additionally, the loss on drying was recorded at 9%, with an ash value of 6.2%, indicating acceptable moisture and inorganic content, while the acid-insoluble ash was low at 0.5%. Further tests demonstrated that the mucilage has a high swelling index (76.23% in water, 64.37% in HCl, and 47.84% in phosphate buffer), showcasing its potential as a super disintegrant or gelling agent. The Molisch test confirmed the presence of carbohydrates, while negative results for alkaloids, steroids, glycosides, tannins, proteins, and saponins suggest the mucilage is free of bioactive compounds that could interfere with drug formulations. Additionally, the mucilage test was positive, confirming its expected properties. Foreign matter was found to be minimal, not exceeding 0.1%. These characteristics collectively position *Mimosa pudica* mucilage as a promising natural polymer for use in pharmaceutical excipients, particularly in formulations requiring viscosity or controlled release.

Table 3 *Physico-chemical characteristics of mucilage*

Sr No	Parameters	Results
1.	Swelling Index	8%
2.	Solubility	"Soluble in warm water, but virtually insoluble in ethanol, acetone, ether, and chloroform."
3.	Loss on Drying	6%
4.	Angle of repose	26.8%
5.	Bulk density	0.73gm/cc
6.	Tapped density	0.81 gm/cc
7.	Carr index (%)	15.78
8.	Hausner ratio	1.15

The *Mimosa pudica* mucilage exhibited notable physicochemical characteristics that support its suitability as a functional polymer in pharmaceutical applications. The swelling index was recorded at 8%, indicating its potential as a super disintegrant, with a moderate capacity for absorbing water and expanding, which is critical for controlled-release formulations. In terms of solubility, the mucilage was found to be soluble in warm water but demonstrated virtual insolubility in common organic solvents such as ethanol, acetone, ether, and chloroform. This solubility profile highlights its compatibility with aqueous-based formulations, making it particularly suitable for hydrophilic drug systems.

The loss on drying was measured at 6%, reflecting the mucilage's moisture content, which is within acceptable limits for pharmaceutical excipients, ensuring stability and minimizing microbial contamination risks. Flow properties were evaluated through the angle of repose, which was determined to be 26.8°, indicating good flowability. The bulk density and tapped density were 0.73 g/cc and 0.81 g/cc, respectively, suggesting moderate compressibility. These parameters resulted in a Carr index of 15.78%, further confirming acceptable flow properties for the formulation of solid dosage forms. The Hausner ratio was calculated as 1.15, which is indicative of a material with minimal flow issues and suitable for tableting processes without the need for extensive flow enhancers.

Table 4 *Data showing the different ash values of Mimosa Pudica Mucilage*

Sr. No	Types of Ash	Ash value in % w/w
1	Total Ash	5.6%
2	Acid insoluble Ash	0.4%
3	Sulphated Ash	0.7 %

The ash values of *Mimosa pudica* mucilage were evaluated to determine the presence of inorganic matter, impurities, and residues, which are crucial for assessing its quality and suitability for pharmaceutical applications. The total ash value represents the total amount of inorganic residue left after complete incineration of the mucilage. A total ash value of 5.6% indicates that the mucilage contains a moderate amount of mineral content, which is within acceptable limits for natural excipients. The acid-insoluble ash value measures the fraction of the total ash that is insoluble in

hydrochloric acid, typically indicating siliceous impurities such as sand or other foreign materials. The low value of 0.4% reflects the high purity of the mucilage, with minimal contamination from inorganic matter.

Conclusion

This study highlights the potential of *Mimosa pudica* mucilage as an efficient and sustainable natural polymer for pharmaceutical applications. The mucilage demonstrated excellent swelling, solubility, and flow properties, which are crucial for its application as a binder, disintegrant, and controlled-release polymer in various dosage forms. Its favourable physicochemical characteristics, including a low acid-insoluble ash value, indicate high purity and minimal inorganic impurities, further supporting its use in drug formulations. With its non-toxic nature, ease of extraction, and eco-friendly profile, *Mimosa pudica* mucilage offers a promising alternative to synthetic polymers, contributing to safer, more sustainable pharmaceutical products. Further research into optimizing its use in modern drug delivery systems can unlock new avenues for its application in the pharmaceutical industry.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article

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