RESEARCH ARTICLE

Isolation of Gum from Tamarind and Fenugreek Plants and Its Evaluation as Pharmaceutical Excipients

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ABSTRACT

In contemporary pharmaceutical dosage forms, a variety of auxiliary substances are combined with active compounds to aid in production and achieve the intended effects of the active components. Plant gum is a widely recognized polysaccharide within the pharmaceutical industry, performing an array of functions including stabilizing, disintegrating, suspending, emulsifying, and gelling. Naturally occurring gum is preferred over commercially produced gum due to its affordability, emollient properties, non-irritating nature, natural composition, and lack of toxicity. The costly nature, hazardous properties, contribution to environmental contamination during production, reliance on non-renewable resources, potential adverse effects, and low patient adherence are all drawbacks of synthetic polymers. Gum exhibits considerable potential as an innovative drug delivery system (NDDS) in conjunction with a variety of pharmacological formulations. The advancements achieved in the application of natural polysaccharides, mucilages, and pectins within the domain of medicinal sciences are examined in this research article.

Keywords: Isolation, Gum, Tamarind, Fenugreek, Evaluation, Pharmaceutical excipients.

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INTRODUCTION

Pharmaceutical excipients are often used in tablet formulation to modify the cohesiveness of the powder combination, hence affecting the flow properties of the particles. Granules are produced by the process of granulation, facilitated by the presence of a binder that promotes the aggregation of particles. The cohesive properties of the granules are modified as they promote the formation of robust cohesive connections between the particles.[1] Proteins and polysaccharides have been the primary foci of study about natural excipients for drug delivery systems. This is due to their exceptional adaptability in creating a wide range of materials and functionalities *via* modifications in their molecular structure. Mucilages have use throughout several sectors. Plant mucilages and gums are extensively used across several industries because to their cost-effectiveness, widespread availability, and substantial contributions to product attributes.[2,3]

The adhesive properties of some plants are harnessed by extracting their sticky and viscous mucilage. Mucilage not only thickens membranes but also serves as a storage for nutrients. Mucilage is an organic substance derived from plants. Its structure is currently unclear, although it has a high molecular weight of 200,000 or more. Mucilage is naturally found in several plants. Mucin has distinct physical properties that set it apart from pectin and other polysaccharides while sharing several chemical similarities with these compounds. Gums undergo swelling to form adhesive colloidal dispersions, whereas mucilage produces viscous and fluid dispersions. On the other hand, pectin transforms into a gel-like substance when mixed with water. Mucilages are present in trace levels in almost all plant species, including certain types of seaweeds, marshmallows, and flaxes, along with other chemical constituents such as tannins and alkaloids (Figure 1). The primary components of mucilages used in industrial settings are linseed, quince seed, slippery elm bark, and locust bean.[4,5]

Pharmaceutical firms are increasingly using natural plant-derived polysaccharides as excipients to tackle formulation challenges and mitigate the adverse impacts of synthetic polymers. When monosaccharide residues are O-glycosidic linked, they generate biopolymers, which are naturally occurring polysaccharides. These excipients consist of mucilages and gums. They possess several potential applications in medicine delivery systems and are now expansively used in the cosmetics and pharmaceutical industries. The pharmaceutical industry uses these compounds for many reasons, such as manufacturing nanoparticles,

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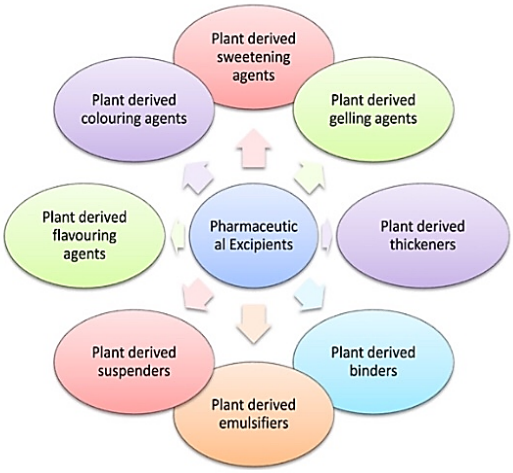

Figure 1: Plant-derived excipient

controlling release systems, and coating agents for films. Polysaccharides and mucilages consist of a diverse range of components, which include polysaccharides.[6-8]

MATERIALS AND METHODS

Collection of the Plant Material

Whole of plant components were gathered from both the botanical garden and the local market(Figure 2). The plant was authenticated by a taxonomist.

Extraction of Gum

The technique for gum extraction was adapted from a process used by gum extraction involving two processes: maceration and precipitation. Precipitation is the use of a particular solvent to isolate gum that has been released into water. To investigate the difference in yield potential, this experiment employed two solvents (acetone and ethyl alcohol) and two temperatures (25°C, which is considered room temperature here, and 50°C, which is obtained by putting the sample in a hot air oven) for maceration and subsequent precipitation. The infusion process included steeping ten grams of leaf powder in 100 mL of water, followed by filtration through an eight-fold muslin textile bag to separate the solid residue.[9-11] Two little beakers were used to collect the filtrate that was generated separately. Each of the two beakers received 150 mL of ethyl alcohol and 150 mL of acetone, with the volume of each component added being three times that of the total filtrate.[12]

- The dried seeds of tamarind and fenugreek were gathered, washed with water to eliminate dirt and debris, and then dried in the shade for a period of 2 to 4 days.
- Desiccated seeds were pulverized into a fine powder, while leaf powder was immersed in water for a duration of 2 to 3 days.
- Filter the powder mixture using muslin cloth to separate the solid particles and collect the liquid filtrate.
- Add an equal amount of ethanol to the filtrate, causing the gum to precipitate. Place the mixture in a refrigerator for 1 day.

Figure 2: Plant part collected from botanical garden and local market

- Then, filter the mixture again and completely dry it in a hot air oven at 37°C. Collect the resulting powder and store it in a tightly sealed container to determine the time it takes for the gum to fully release.[13]

Physicochemical Characterization of Gum

Determination of purity

The gum's purity was determined by testing it for several substances such as alkaloids, carbs, flavonoids, steroids, saponins, tannins, and phenols.[14]

Identification of gum

After preparing a 2-mL solution of gum in water, 2.5 mL of pure alcohol were added. The extracted sample underwent analysis to detect the presence of gum using a range of established phytochemical screening tests. Gum identification The addition of ruthenium red solution to the gum granules caused the development of a pink coloration.[15]

Organoleptic evaluation

Organoleptic evaluation involves the examination of specific attributes, such as texture and odor, as well as aspects including color, taste, shape, and touch. Most of the information on the substance's identity, quality, and integrity comes from these observations.[16]

- *Solubility*

The solubility of tamarind and fenugreek powder was assessed using several solvents.

- *Melting point*

The powdered samples of tamarind and fenugreek were placed into a capillary tube and their melting points were evaluated using a melting point instrument.

- *Moisture absorption*

Hygroscopicity gum powder was precisely measured and put in a desiccator. Following a period of 3 days, the gum powder was extracted and measured in terms of weight. The moisture absorption% was determined by subtracting the beginning weight from the end weight, and then dividing the result by the original weight.[17]

- *Loss on drying*

The loss on drying technique was used to determine the relative humidity of tamarind and fenugreek gum. To maintain the mass of a carefully measured one-gram sample, a hot air oven

was used to heat it to 105°C. The following method was used to as certain% of moisture that was lost during dehydration.

$$\text{LOD (\%)} = \frac{\text{Weight of moisture in sample}}{\text{Weight of sample before drying}} \times 100$$

- *pH*

Gum's pH level The pH of a 1% weight/volume dispersion of gum was measured using digital pH meter.

- *Thermal stability*

Thermal stability refers to the capacity of a substance to resist decomposition or changes in its physical or chemical properties when exposed to high temperatures. A suitable amount of tamarind and fenugreek powder was placed in a petri dish and subjected to increasing temperatures in succession. The temperature at which the powder's color changed in a way that could be seen was written down.[18-20]

Angle of repose

The circulation angle was determined using the funnel method.[21] The liquid was poured using a vertically adjustable funnel to attain maximum cone height (h). The formula provided was used to calculate radius of the heap (r) and establish the angle of repose (θ).

$$\mathbf{Tan\ \theta = h/r}$$

Where, θ is the angle of repose, h is height of the cone, r is the radius of a cone.

RESULT AND DISCUSSION

Physical Characterization of Tamarind Gum

Organoleptic characterization of isolated gum

The isolated mucilage can be characterized as an amorphous brown substance that possesses a discernible odor. It produced a viscous, colloidal solution with a neutral pH and a greenish-brown hue upon dissolution in water. The observed sensory attributes of the isolated gum are detailed in Table 1.

- *Solubility testing*

The crude latex gum showed a low solubility, even by using different types of solvents (Table 2).

- *Moisture content*

The moisture content of latex gum as a function of drying time at a 105°C. Data indicates that the starting moisture level of 16% decreased to 4, 2, and 1% at 10-minute intervals over a period of 70 minutes until the moisture content reached a steady state.

FTIR spectra

FTIR analysis revealed a signal at 3266 cm^{-1}, indicating the presence of hydrogen crosslinking and O-H stretching in water molecules, notably alcohol and phenols (Figure 3). The different types of aldehydes and ketones display -C stretching, represented by the symbol 1721 cm^{-1}. The compound-type alkenes exhibit a C=C stretching vibration with a wavenumber of 1601 cm^{-1}. The alkane compound exhibits C-H bending at a wavelength of 1372 cm^{-1}. Stretching of the C-N bond is seen by peak at 1241 cm^{-1} in molecules classified as amines. Peak 1036 cm^{-1} signifies the stretching of C-O bond in a primary alcohol molecule. Samrot *et al*. (20) detected specific peaks at 3417 cm^{-1} representing O-H stretching, 2940 cm^{-1} representing alkenes, 1300 to 1450 cm^{-1} representing the aldehyde group, and 1725 cm^{-1} representing the gum.

Table 1: Organoleptic characterization of isolated gum

Tests	*Observations*
Colour	Brownish
Odour	Odourless
Taste	Characteristic bitter
Shape	Irregular
Texture	Amorphous

Table 2: Solubility of latex gum in various solvents

Solvents	*Solubility*
Water	Partially dissolvable
HCL	Dissolvable
DMSO	Non-dissolvable
Ethanol	Non-dissolvable
Acetone	Non-dissolvable
Methanol	Non-dissolvable

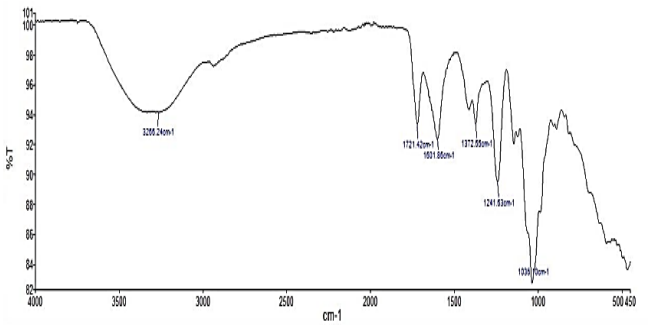

Figure 3: FTIR analysis of the Tamarind gum extract

- *Melting point*

Melting point of tamarind gum powder were found to be 109°C.

- *Loss on drying*

The weight loss on drying was found to be 11.10%.

- *pH of gum*

pH of the gum, measured in a 1% solution, was found to be 6.4. This pH value, which is close to neutral, suggests that the mucilage may cause less irritation to the mucosal membrane and gastrointestinal system when taken orally. The pH of a 1% solution of tamarind gum was measured and found to be 6.4.

Viscosity

The viscosity of the 1% solution was determined to be 2.1435 poise. It may be inferred that the mucilage has a viscosity that is appropriate for the creation of gel, jellies, and films.

Physical Characterization of Fenugreek Gum

Phytochemical properties

The gum content of fenugreek seeds was recovered at a concentration of 25% w/w after their separation by a process of hot water extraction and ethanol treatment. Carbohydrates were detected in the fenugreek seeds gum (FSG) purity analysis findings. The isolated substance lacked any further phytoconstituents. This exemplifies the integrity of the isolated gum. The findings were documented in Table 3.

Organoleptic properties

The organoleptic features test yielded supplementary data on the texture, color, odor, taste, and fracture of the isolated gum. The researchers noted that FSG had a bitter flavor and a yellow tint. The fracture of the individual FSG gum displayed a coarse and irregular texture. The outcome was shown in Table 4.

Solubility of FSG

The solubility of FSG in several organic solvents. The FSG exhibited insolubility in several organic solvents. It produced thick colloidal dispersions. The findings are shown in Table 5.

Physicochemical properties

The assessment of the physicochemical characteristics of fenugreek gum yielded findings that are shown in Table 6. Each of these values was found to be within the range of the reference values for natural gum. The isolated FSG has the following properties: a bulk density of 0.667, a tapped density of 0.809, a vehicles index of 17.55, an H.R. of 1.246, a moisture content of 21.40%, ash values of 5.98, a pH of 6.7, and an angle of repose of 27.85 degrees.

- *pH values*

The pH values of the 2% FSG solution ranged from moderately acidic to almost neutral. The results show that the FSG can be used to make buccal and oral drug delivery systems because it doesn't irritate the mucous membranes in the mouth or GI tract.

- *Swelling index*

Swelling index of FSG was 10.2 mL, indicating a remarkable capacity for water absorption. As a result, the medication has the potential to be released by diffusion from this hydrated three-dimensional network.

- *Moisture content%*

The hygroscopic nature of a material is determined by its level of moisture absorption. Adding hygroscopic excipients has the capacity to modify certain attributes of dosage forms. Because of this, it is very important to find out how hygroscopic the excipient is and how much water it can hold. According to the results of this study, FSG was able to absorb water and should be kept in containers that keep air out.

- *Viscosity*

The FSP had a flow that ranged from average to satisfactory. Therefore, glidants are necessary to enhance the flow. Viscosity of isolated FSG was measured on first day at concentrations of 0.4, 0.8, and 1%, resulting in viscosities of 33, 34, and 43 cP., respectively. The viscosity was measured on the following day at concentrations of 0.4, 0.8, and 1%, corresponding to viscosities of 33, 35, and 45 cP., respectively. It was shown that higher concentrations of FSG resulted in a decline in rate at which medicine was released, owing to the gelling or swelling characteristic of FSG.

FTIR spectra

Figure 4 exhibited the FTIR spectra of the FSG, revealing that the FSG mostly included polysaccharides. The absence

Table 3: Phytochemical tests of FSG gum powder

Test	*Results*
Tannins (Ferric chloride test)	-
Monosaccharide test	-
Mucilage (Ruthenium red test)	+
Alkaloids (Wagner's test)	-
Proteins (Ninhydrin test)	-
Carbohydrates (Molisch's test)	+
Flavonoid (Shinoda test)	-
Glycosides (Keller – Killaini test)	-
Reducing sugar (Felhing's test)	-

Table 4: Organoleptic tests of isolated FSG powder

Colour	*Fracture*	*Gums*	*Taste*	*Odour*
Yellow	Irregular	FSG	Bitter	Characteristics

Table 5: Solubility of isolated FSG powder

Solvents	*Results*
Ethanol	Insoluble
Hot water	Viscous colloidal dispersion
Cold water	Slightly soluble
Acetone	Insoluble
Benzene	Insoluble

Table 6: physicochemical properties of FSG powder

Parameters	*Results*
Swelling Index	10.2ml
Solubility	Slightly soluble
Percentage yield	25%
Bulk Density	0.667
Angle of repose	27.85
Carr's index	17.55%
Tapped Density	0.809
Moisture Content%	21.40
H.R	1.246
Ash content%	5.98
Melting point	248-2560C
pH of mucilage	6.7

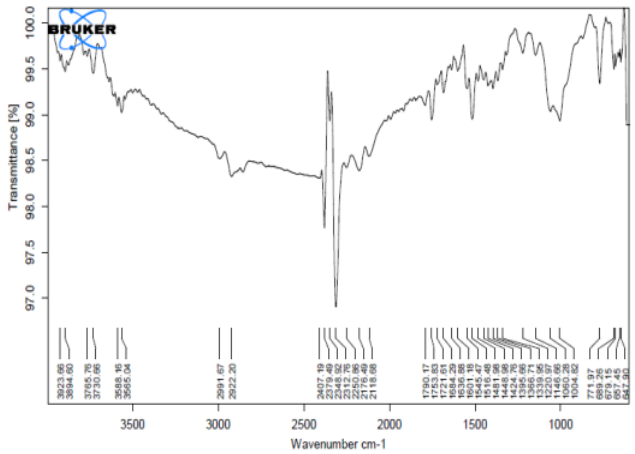

Figure 4: FTIR spectra of FSG

of a carboxyl group was identified by a distinctive peak in the FTIR spectra located within the range of 1700 to 1800 cm^{-1}. The identification of an alcohol group, primarily secondary alcohols, was indicated by the peak seen in the wavelength range of 1000 to 1200 cm^{1}. The presence of these peaks in the FTIR spectrum suggests the absence of esters in the structure. The spectral region spanning from 800 to 1200 cm^{-1} exhibits the distinctive features associated with carbohydrates.

CONCLUSION

Gum, a significant polysaccharide included in medicines, fulfills several roles, including stabilizing, dissolving, suspending, emulsifying, and gelling. The choice to use organically derived gum instead of synthetic gum is motivated by its economic value, non-hazardous characteristics, moisturizing attributes, and absence of discomfort. Natural polymers have been used in various formulations as agents for gelling, emulsifying, suspending, and binding. Biodegradable polymers, such as gums and other natural compounds derived from different biological sources, are used in the pharmaceutical, cosmetic, and food sectors. Research indicates that synthetic polymers are comparatively costlier, less risky, and less beneficial than natural polymers.

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