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Extraction And Characterization Of Mucilage From *Tamarindus Indica*

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Abstract: This project focuses on the extraction and characterization of mucilage from Tamarindus indica, commonly known as tamarind. Tamarind mucilage is a polysaccharide-rich substance with potential applications in various industries, including food, pharmaceuticals, and cosmetics. The extraction process involves optimizing parameters such as temperature, solvent type, and extraction time to achieve maximum yield and quality of mucilage.

The extracted mucilage is subjected to thorough characterization using various analytical techniques. Physicochemical properties, such as viscosity, solubility, and moisture content, are assessed to understand the material's behavior and potential applications. Structural elucidation is performed using techniques like Fourier-transform infrared spectroscopy (FT-IR) and nuclear magnetic resonance (NMR) to identify functional groups and molecular composition.

Furthermore, the rheological properties of tamarind mucilage are investigated to evaluate its suitability for specific industrial applications. The project aims to provide valuable insights into the potential uses of tamarind mucilage as a natural and sustainable resource, contributing to the development of eco-friendly products and processes. The findings of this research may open avenues for the utilization of tamarind mucilage in various sectors, promoting sustainable practices and reducing dependency on synthetic alternatives.

Keywords: Tamarindus indica, Mucilage extraction, Characterization, Viscosity, Solubility.

1.Introduction:

Mucilage's are complex polymeric substances of carbohydrate nature, with a highly branched structure, which contains varying proportions of L-arabinose, Dgalactose, L-rhamnose and D-xylose, as well as galacturonic acid in different proportions.

Mucilage is similar to the plant gums and is defined as a gelatinous substance which is present in plants such as seaweeds and legumes. The mucilage in plants play roles such as storing water and food, helps in thickening the membranes, and seed germination.

Origin of Mucilage in Different Plant Parts:

The Mucilage is a water-soluble edible adhesive material that constitutes carbohydrates and uranic acids units present in different parts of plants including the mucous epidermis of the outer layer of seeds, bark, leaves, and buds3. The majority of plants produce mucilage from the seed coat and this process of producing mucilage is termed Myxospermy and some plant species produce it from the fruit epicarp which is known as Myxocarpy. Plants producing mucilage from seed coat belong to the family Plantaginaceae, Acanthaceae, Linaceae, and Brassicaceae, while Myxocarpy is commonly found in families like Poaceae, Asteraceae, and Lamiaceae . The presence of mucilage on the seed coat prevents the plant from early seedling development and drought stress during the germination. depending upon its origin it is characterized into many groups including hair secretion, intracellular mucilage, and cell membrane mucilage. The mucilage obtained from the seed coat is classified into three classes that are endosperm.

Polymers 2021,13, 1066 3 of 24non-starch polysaccharide cell wall material of the endosperm ,and mucilaginous constituents of the seed coat. Mucilage develops a jellylike structure around fruit and maintains moisture and prevents seeds from completely drying out and therefore act as a hydrating agent and also acts as an energy reservoir. Mucilage also plays asignificant role in the control of germination, the promotion of dispersal, and soil adhesion, root mucilage is usually exhibited from the outer layers of the root cap, consisting of mostly root border cells and polysaccharides, which produce various chemical substances such as flavonoids, phenolics acids, amino acids, galactosidase, antibiotics, sugars, peroxidase, proteins, and anthocyanins. Moreover, root mucilage plays a very important role for plant growth, such as for the maintenance of root-to-soil touch, root tip lubrication, soil microaggregate stabilization, water storage ability, selective storage, and the absorption of ions through root cells. Furthermore, it is primarily secreted by the secretory vesicles of hypersecretory root cap cells as a coagulated polysaccharide and is subsequently passed during root extension to older root areas, but epidermal cells are also effective in secreting mucilage . Mucilage is also produced in the leaves and buds of several plant species; it may allow the leaves to retain water capacity when soil water deficits emerge; therefore, it helps in the storage of food and water.

Tamarind (Tamarindus indica) is an economically important tree, found in many countries in Asia, Africa and South America. The tree can grow to a maximum height of 25 m and a crown diameter of 12 m. It is ideal for drier-arid regions, especially in areas prone to prolonged drought. Tamarind can tolerate five-six months of drought conditions; hence tamarind crop can grow in any type of climate. Tamarind is a tree that is easy to cultivate and requires minimum care. It is generally free of serious pests and diseases, and has a life span of 80-200 years, and can yield 150-500 kg of pods per healthy tree/year at 20 years of age. During each season, the tree bears curved fruit pods in abundance covering all over its branches. Each pod has hard, outer shell encasing deep brown soft pulp enveloping around two-ten hard dark-brown seeds. Its pulp and seeds held together by extensive fiber network.

Tamarind seed polysaccharide is a natural polysaccharide. Tamarind seed polysaccharide contains monomers of galactose, xylose and glucose sugars with each other by covalent bonds. Polymers are used present in a molar ratio of 3:1:2, which constitutes 65% of the seed components. Xylose is very crucial sugar of tamarind seed, which can be used for xylitol production, Tamarind seed polysaccharide is mainly water soluble polysaccharide

As tamarind seed is a byproduct from pulp industry and the hydrocolloids which are in food uses are expensive. So, an attempt was made to extract the mucilage from tamarind kennel. As the mucilage doesn't possess any shelf life properties it is spray dried to evaluate for hydrocolloidal properties.

Therefore, the aim of the present study was to extract and evaluate the functional properties and physicochemical characteristics of tamarind seed mucilage powder with the following objectives: a. Extraction of tamarind seed mucilage and spray drying b. Evaluation of spray dried mucilage for its functional and physico chemical properties.

Fig.01 Tamarind seeds.

Natural products always take over synthetic ones due to their easy availability, non-toxicity, capability of chemical modifications, potential biodegradability and bio-compatibility property, as compared to the expensive synthetic polymers with environment related issues, long development time for synthesis and toxicity which makes them undesirable. Now-a-days, natural gums, obtained mainly from seeds or other plant parts, have become a thrust area in majority of investigations in drug delivery systems, switching from the synthetic excipients available in the market. Recent researches show that tamarind gum hasbecome a potential polymer in pharmaceutical industries. The tamarind seed is a by-product of the tamarind industry. The decorticated flour, known as tamarind kernel powder has been tried for various biomedical applications such as drug delivery carriers.

2. Aim and Objectives:

Aim: Extraction And Characterization of Mucilage from *Tamarindus indica*

Objectives:

- **To extract & formulate mucilage from *Tamarindus indica*.**
- **To evaluate prepared mucilage of *Tamarindus indica* by following parameters.**

  - Physicochemical characterization
  - Bulk density
  - Tapped density
  - Angle of repose
  - Carr's index
  - Hausner's ratio
  - pH determination
  - Solubility
  - Viscosity

3.Materials & Methods:

3.1 Table of Materials:

Table No: 3.1:Materials

SR NO.	Name of material	Procured from
1	Distilled Water	Distillation plant in college
2	Ethanol	Ozone International, Mumbai
3	Tamarind (*Tamarindus indica*)	Local Markt
4	Muslin cloth bag	Peacock Medical, solapur

3.2 Table of Equipment:

Table No: **3.2:Equipments**

SR NO.	Name of equipment	Model Make
1	Hot air oven	Shreeji chemical
2	PH meter	SYSTRONIC µ pH System 361
3	viscometer	DV-I + Pro (Brookfield)
4	Mortar pestle	Marble and wood
5	Tap density apparatus	Campbell Electronics
6	Weighing balance	OKAUS

3.3 METHODS:

3.3.1 Selection of crude drug:

By review of literature, we selected *Tamarindus indica* as our crude drug.

3.3.2 Preparation of mucilage of *Tamarindus indica*:

- Tamarind seeds were separated from their pulse by hand, then the seeds were washed with tap water and dried in an oven at 100 °C for 30 min.
- The seeds were allowed to cool down to room temperature and then lightly ground for 0.5–1 min in a blender to separate the brown peels from the kernel seeds.
- The kernel seeds were finally ground into powder with a blender.
- Take 200 ml of cold distilled water and add it into 20 gm of TSP and prepare the slurry.
- The slurry should be poured into 800 ml of boiled water for 20 minutes to give clear solution and store overnight. Thin clear solution centrifuged with 6000 rpm for 20 minutes to separate the foreign material .
- The supernant should be separated and poured into 95% ethanol with continuous stirring in proper manner .
- The obtain precipitate should be corrected using a stainless sieve and dried into oven at 50^0C temperature for 4 hours . The dried polymer should be stored in an clean desicator.

Fig.No.02 Preparation of Tamarind seed mucilage

3.4 Evaluation of prepared mucilage of *Tamarindus indica* :

➢ **Physicochemical characterization of isolated mucilage:**

- **Organoleptic characterization:**

  Organoleptic characterization of prepared mucilage was done by senses such as smell, touch and visual observation.

- **Solubility studies:**

  Solubility of mucilage of Tamarind seed was studied by using different solvents such as ethanol, water, acetone, chloroform and glycine.

➢ **Bulk density**:

Accurately weighed 25gm of powder and placed in dry graduated measuring cylinder and noted volume as V1 ml. Calculated bulk density as per given formula.

$$\text{Bulk density} = \frac{\text{Mass } (W_1)}{\text{Bulk volume } (V_1)}$$

➢ **Tapped density:**

Accurately weighed 25gm of powder and placed in dry graduated measuring cylinder and noted volume as V1 ml. Adjusted apparatus for 100 tapping and operated it Calculated bulk density as per given formula.

$$\text{Tapped density} = \frac{\text{Mass } (W_1)}{\text{Tapped volume } (V_1)}$$

Fig.No.03:Tapped Density Apparatus

➢ **Determination of Angle of repose:**

1. Took a clean of dry funnel with round stem of 20-30 mm diameter with flat tip was attached to the burette stand.

2. Placed burette stand. a graph paper sheet below the funnel clean & dry platform.
3. Adjusted the distance between lower tip of funnel 4 sheet to specified height (10mm or 20m)

4. Gently poured Sample in funnel from top till a hip of powder Forms and touches the lower tip of Funnel. Used a pencil to draw a circle around the heap. Covering approximately 90% of of powder. Repeated the procedure 3 times to obtain average reading.

5. Found out diameter & radius of each drawn circle. $\emptyset = \tan^{-1} h/r$. $\emptyset$= is the angle of repose. h=height of pile (cm), r = radius of pile (cm).

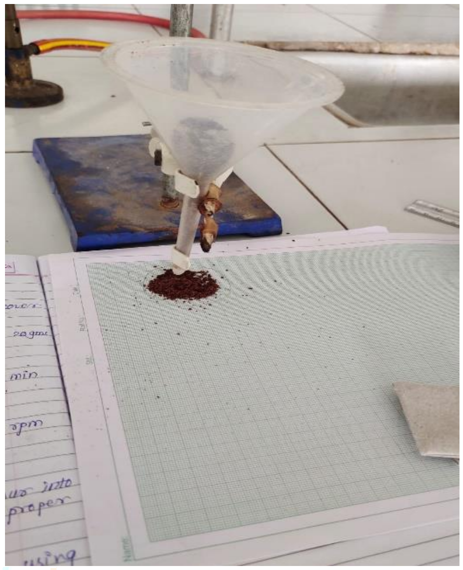

Fig.No.04:Angle of repose

- **Carr's index:**

Table No:3.3:Carr's Index

Compressibility%	**Relative flowability**
5-15	Excellent
12-16	Good
18-21	Fair
23-28	Slightly poor
28-32	Poor
32-38	Very poor
≥40	Extreme poor

$$\text{Carr's index} = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}}$$

- **Hausner's Ratio**

Table No:3.4:Hausner's Ratio

Flow character	Hausner's ratio
Excellent	1-1.11
Good	1.12-1.18
Fair	1.19-1.25
Passable	1.26-1.34
Poor	1.35-1.45
Very poor	1.46-1.59
Very very poor	≥1.60

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

➢Determination of pH:

Plugged in the pH meter to power source and let it warm up for 5 to 10 minutes. Washed the glass electrode with distilled water and cleaned slowly with a soft tissue. Noted the temperature of water and set the same on the pH meter. Placed the electrode in pH 7 buffer solution and set the value of 7 on the pH meter turning the Calibrate knob on the meter. The electrode was dipped in the pH 4 buffer solution and adjusted the value on the pH readout. The electrode was placed in the mucilage solution whose pH was determined.

Fig No.05 pH meter

➢ **Determination of Viscosity:**

The base level of instruments was set by using level indicator on top of instrument and electric supply was provided constantly. Spindle was cleaned and attached to instrument. Spindle was rotated in mucilage solution, got a constant dial reading on the display of viscometers. Determination was repeated for at least three times for reproducible results. Constant temperature was maintained

Fig No.06 Brookfield apparatus

4.Result & Discussion:

a **Selection of crude drug:**

By review of literature, we selected *Tamarindus indica* as our crude drug.

b **Preparation of mucilage of *Tamarindus indica*:**

After extraction & preparation of mucilage from the seeds of *Tamarindus indica* we got 7 grams of yield from 60 grams of Tamarind seed that is about 8.5%

c **Evaluation of prepared mucilage of *Tamarindus indica*:**

➢ **Physicochemical characterization:**

- **Organoleptic characterization:**

Organoleptic properties of Mucilage obtained from seeds of *Tamarindus indica* are shown in following table:

Table No :7.1 : Physiochemical Characteristics

Sr.no	Test	Observation
1	Color	Brownish red
2	Odor	Characteristic
3	Texture	Crystalline

- **Solubility studies:**

Solubility studies of prepaed mducilage obtained from seeds of *Tamarindus indica* are shown in following table:

Table No: 7.2: Solubility

Sr.no	Solvent	Observation
1	Cold water	soluble
2	Benzene	Insoluble
3	Ethanol	Insoluble
4	Acetone	Insoluble
5	Chloroform	Slightly soluble
6	Glycine	Floating insoluble

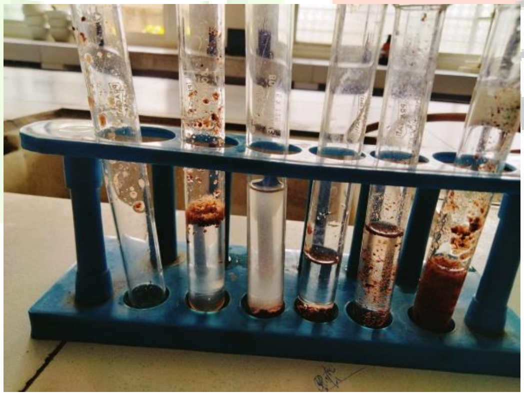

Fig No.08 Solubility studies

Bulk density:

Bulk density prepared of *Tamarindus indica mucilage* was found to be 0.7 gm/ml.

Tapped density:

Tapped density prepared of *Tamarindus indica mucilage* was found to be 6.8 gm/ml.

Angle of repose:

Angle of repose is used as an indicator of the flowability of bulk solids such as powders.

Angle of Repose prepared of *Tamarindus indica mucilage* was found to be 29.85^0

Carr's index:

The Carr's index (also: Carr's index or Carr's Compressibility Index) is an indicator of the compressibility of a powder. It is named after the scientist Ralph J. Carr, Jr.

Carr's index prepared of *Tamarindus indica mucilage* was found to be 89%.

Hausner's ratio:

Hausner's ratio is defined as the ratio of a powder's tapped bulk density to its poured (loose) bulk density.

Hausner's ratio prepared of *Tamarindus indica mucilage* was found to be 9.71.

pH Determination:

By using pH meter, we found out that pH value of mucilage of *Tamarindus indica* was
4.51 (slightly acidic) at 28.8 c.

Viscosity:

At 20, 50 and 100 rmp viscosity was found to be 64c.p, 25.6c.p and 12.8c.p respectively.

5.Conlusion:

We prepared the mucilage from Tamarind seeds & then evaluated mucilage by using parameter such bulk density (0.7g/ml), tapped density (6.8g/ml), angle of repose (29.85^0), carr's index (89%), hausners ratio (9.71), pH determination (4.51) and viscosity(64c.p.,25.6c.p.,12.8c.p.), And hence we concluded that mucilage (*Tamarindus indica*) has good flowing properties.

From the results it can be concluded that prepared mucilage from Tamarind seeds having solubility in water, acetone and insoluble in ethanol, glycine, it shows good flowing properties, slightly acidic pH and low viscosity.

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