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Isolation and Characterization of Mucilage from *Colocasia esculenta*

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ABSTRACT

From the last few decades, the importance of the search for natural polymer as pharmaceutical excipients has been increasing due to their various advantages. The natural polymer has been used in different pharmaceutical formulations. They are easily available, non-toxic, biodegradable and less cost. The synthetic polymers used as excipients suffer from many disadvantages such as high cost, toxicity, non-biodegradable and environmental pollution caused during their synthesis. In the present study, mucilage was isolated from the corms of *Colocasia esculenta.* The mucilage was extracted using distilled water and isolated by the two methods such as precipitation with ethanol and acetone. The mucilage was characterized by various physicochemical properties such as solubility, pH, swelling index, and preliminary phytochemical studies. The micrometric properties of mucilage such as bulk and tapped densities, Carr's index, Hausner's ratio and angle of repose were also evaluated. The result showed that extracted taro mucilage exhibited good flow properties (Angle of repose 25°), Swelling index was 27% and pH was found to be 6.5. Extracted mucilage swells in water and slightly soluble in organic solvents. The preliminary phytoconstituents studies showed the presence of carbohydrates, mucilage, and phenolic compounds. FT-IR studies show that presence of O-H and aliphatic C-H stretching. Results of evaluated parameters showed that *Colocasia esculenta* derived mucilage can be used as pharmaceutical excipients to formulate different dosage form. It has acceptable pH and organoleptic properties so can be easily used in the various dosage form.

INTRODUCTION

Excipients are the largest components of any pharmaceutical formulation. They can be of natural or synthetic origin and synthetic excipients have become commonplace in today's pharmaceutical dosage forms. [1] It is common knowledge that both synthetic and semi-synthetic products have enjoyed a long history of use, frequently offering unique properties and advantages over naturally derived compounds, including a low sensitivity to various ingredients or moisture, resulting in more efficient and effective pharmaceutical products. [2]

These pharmaceutical excipients obtained from the natural sources play a more important role as compared to the synthetic pharmaceuticals. [3] These natural polysaccharides are being widely used in the pharmaceutical industry due to their advantageous properties such as low cost, relative abundance, and biocompatibility as compared to their synthetic ones. Natural polymers are obtained from either plant origin or animal origin. These natural polymers are used as gelling agent, binding agent, bulking agent, lubricating agent, sweetening agent, flavoring agent, and suspending agent. The characterization of pharmaceutical excipients using a material science approach has helped in the design of drug formulations to obtain a desired set of performance properties. Characterization of excipients becoming increasingly apparent that there is an important relationship between the properties of the excipients and the dosage forms containing them. Preformulation studies demonstrate their influence on stability, bioavailability and the process by which the dosage. Forms are prepared. This calls for the need for acquiring more information and use standards for excipients.

Mucilage is water soluble, sticky and gummy substance obtained from some plants. In plants, it acts as a membrane thickener and food reserve. [4] Mucilage occurs in almost all classes of plants in various parts of the plant, including marshmallows, flaxes, and certain seaweeds in relatively small percentages and other substances such as alkaloids and tannins are also rarely found.

Taro [*Colocasia esculenta* (L.) Schott; Araceae], an annual herbaceous plant from tropical and sub-tropical regions and a member of the Araceae superfamily is a low-cost and widely consumed staple food in the human diet. Its corms provide important nutritional components such as carbohydrates, protein, thiamine, riboflavin, niacin, oxalic acid, calcium oxalate, minerals, lipids, unsaturated fatty acids, and anthocyanins.[5]

MATERIALS AND METHODS

Taro corms were procured from the local market of Mandleshwar. All the other solvents, reagents and chemicals used were of analytical grade.

Isolation of mucilage[6]

About 200 gm of Fresh taro corms were washed to polish off the adherent soil material later peeled and Soaked in water for 12 hours and made in a smooth paste. Taro corm paste was suspended in 1% NaCl solution and stood for 1 hour. The slurry was passed through a muslin cloth. The filtrate was collected and an equal amount of acetone was added and stirred for few minutes, the mucilage was carefully separated. The mass then dried in a tray drier until it completely dried. After complete drying, the powder was sieved using mesh #20 and stored for further use.

Characterization of isolated mucilage [7-10]

Isolated polymer was characterized by the following methods and reported procedure of published literature.

➢ **Percentage yield:-** Dried mucilage powder was weighed and the percentage yield was calculated.

$$\text{Percentage yield} = \frac{\text{Practical yield}}{\text{Theoretical Yield}} \times 100$$

➢ **Organoleptic evaluation of isolated mucilage powder:-** Isolated mucilage was characterized for organoleptic properties such as color, odor, taste, fracture, and texture.

➢ **Identification test for mucilage:-** Ruthenium test: take a small quantity of dried mucilage powder, mount it on a slide with ruthenium red solution and observe under the microscope. When pink color develops mucilage present.

- **pH of mucilage:-** Mucilage sample 5 gm was weighed and mixed with 20 ml of distilled water, the resulting suspension stirred for 5 minutes and the pH was measured using pH meter.

- **Solubility Behavior of mucilage:** One determined Solubility part of the mucilage powder was shaken with different solvents.

- **Swelling Index of Isolated mucilage: - The** swelling behavior of mucilage was tested in distilled water. The swelling index is the volume in ml occupied by 1 gm of substance. The swelling index determined by accurately weighing 1 gm of mucilage which was introduced into 25 ml glass stoppered measuring cylinder then 25 ml of distilled water was added and the mixture was shaken thoroughly every 10 min for 1 hour and then allowed to stand for 24 hrs at room temperature. The volumes occupied by the mucilage were measured. The procedure was repeated for three times and mean values were calculated.

- **Bulk density & Tapped density:** Fifty ml capacity of measuring cylinder was used and filled with 20 gram of mucilage powder, the bulk and tapped volume of mucilage was determined. Bulk and Tapped density of mucilage powder were calculated using equation 1 and 2

Bulk density = 20/Bulk Volume………………..(1)

Tapped density = 20/Tapped Volume……………………(2)

- **Carr's Index and Hausner Ratio Determination:-** Data values Obtained from Bulk density and tapped density above equation value was used to calculate the Carr's index and Hausner ratio, equation 3 and 4

$$\text{Carr's index} = \frac{100 \times (TD-BD)}{TD} \quad \ldots\ldots\ldots\ldots\ldots(3)$$

Hauser ratio = TD/ BD………….. (4)

- **The angle of Repose determination: -** it was determined by using fixed height funnel method and equation.

The angle of repose =Tan$^{\theta}$ h/r

Where h is the height of the powder heap,

r is the radius of the powder heap.

- **Viscosity: -** Viscosity of mucilage was determined using 1% solution of mucilage powder in distilled water. The viscosity was measured using an Ostwald viscometer.

- **Particle size: -** Particle size of the mucilage powder was determined by using the microscopic method.

- **Infrared spectra of the isolated mucilage: -** 100mg of the powdered pectin was mixed with potassium bromide (400mg) and was compressed in a hydraulic press to form a pellet at 15 tones pressure. The pellets were scanned from 4000 to 400 cm^{-1} in Shimadzu spectrophotometer.

RESULTS AND DISCUSSIONS

Isolation of mucilage

From the two methods employed such as acetone precipitation and ethanol precipitation method, acetone precipitation method was preferred since it gave a high yield.

Characterization of the isolated mucilage

Physical characterization

Organoleptic properties: The organoleptic properties of the isolated mucilage were depicted in the table in which color of isolated mucilage was found to be white with characteristic taste and odorless odor.

Organoleptic properties are tabulated in (Table 1).

Fig No. 1: Isolated Natural mucilage

Table No. 1: Organoleptic properties of taro mucilage

Parameter	Observation
Physical state	Fine powder
Color	White
Odor	Odorless
Taste	Characteristic
Fracture	Smooth

Iodine test:- 100 mg of dried mucilage powder dissolved in 1ml of 0.2 N of iodine solution.

Test	Observation
Iodine test	+

Solubility

The solubility test was performed using various solvents. The results are tabulated in Table 2.

Table No.2: Solubility profile of taro mucilage in different solvents

Solvents	Solubility
Cold water	Swell to form a gel
Hot water	Soluble
Ethanol	Insoluble
Benzene	Insoluble
Acetone	Insoluble
Hydrochloric acid	Insoluble
Phosphate buffer	Insoluble

Physicochemical properties:-

Percent Yield: - Dried mucilage was weighted and the percent yield was calculated.

Swelling index: - 5mg of mucilage powder was weighted. Then introduced in 50ml of measuring cylinder and added 25ml of water. Then stand for 12 hr. after 12 hrs swelling of powder was calculated.

Bulk density: - 20 gm of mucilage powder was introduced in clean and dry 50ml measuring cylinder and the bulk volume was recorded. Then calculated by using this formula –

$$\text{Bulk density} = M / V$$

M= mass of the powder, V= volume of the powder

Tapped density: - 20 gm of mucilage powder was introduced in clean and dry 50 ml measuring cylinder. The cylinder was tapped until the powder- bed volume reached a minimum value, and the tapped volume was recorded.

Carr's index: - Carr's index and Hauser's ratio was calculated from the bulk and tapped densities using the following formula

$$\text{Carr's index} = \frac{TD-BD}{TD} \times 100$$

$$\text{Hauser's ratio} = TD/BD$$

An angle of Repose:- Angle of repose of mucilage powder was determined by fixed funnel and cone method. The material was poured through a funnel to form a cone. A thumb closed the tip of the funnel. After then removed thumb and the height and radius of the pile were measured and the angle of repose was calculated by the equation.

$$\tan \theta = H/R$$

Where H is the height of the cone and R is the radius of the cone base

Result: the angle of repose is given in table

Viscosity: viscosity measurement of the mucilage powder was carried out using 1% solution of mucilage in distilled water. The viscosity was measured using an Ostwald viscometer.

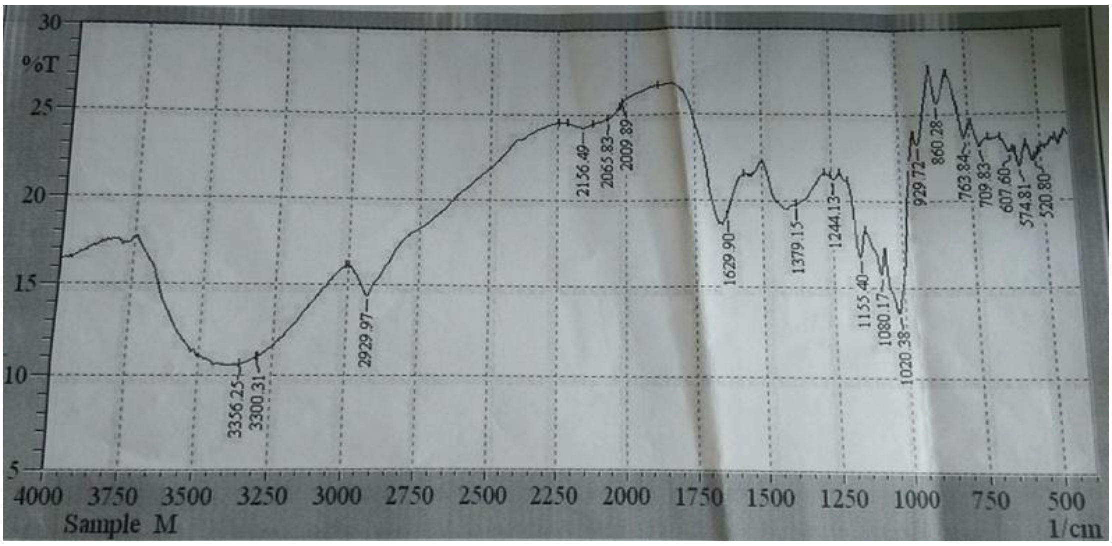
pH: pH of the 1% solution of the mucilage were measured with digital pH meter.

Table No. 3: Physicochemical properties of taro mucilage

Parameters	Observations
Percent Yield	21%
Swelling index	27
Bulk density	0.66 g/ml
Tapped density	0.8 g/ml
Carr's index (%)	25
Houser's ratio	1.212
Angle of repose	25^0
Viscosity	1.1152 cps
PH	6.5

FT-IR spectral analysis

The spectra of the mucilage were taken using FTIR (IR Affinity-1 Shimadzu) in the range of 400-4000 cm-1. The spectra of the mucilage (Table 4 & Fig. 2) showed peaks at 3300.31, 1020..38, 2929.97 cm-1, these could be due to O-H stretching, aliphatic C-H stretching, respectively



Graph No. 1: FT-IR of Natural polysaccharide (Taro mucilage)

Table No. 4: Characteristic frequencies in FT-IR of Taro mucilage

S. No.	Wave No. (Cm⁻)	Inference
1.	929.72 and 1155.40	C-O Stretching
2.	1020.38 and 1080.17	O-C Stretching
3.	3300.31 and 3356.25	O-H Stretching
4.	2929.97	C-H Stretching

CONCLUSION

The project deals with the isolation of mucilage from natural source i.e. *Colocasia esculenta* and its physicochemical and Micrometric characterization. The chemical characterization of mucilage revealed the presence of carbohydrates. The physical characterization of mucilage was all in a range, which indicates it, is safe to be used as excipients. The micrometric characterization indicated the good flow property of mucilage.

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