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Extraction and characterization of opuntia stricta cladodes mucilage as pharmaceutical excipient

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ABSTRACT

This study deals with extraction and characterization of mucilage extracted from cladodes of Cactus (*Opuntia stricta*) as pharmaceutical excipient. With the use Acetone based extraction method, the yield of mucilage was found to be 1.44%. Characterization of the extracted mucilage was done by various parameters such as micromeritic studies, flow behavior, organoleptic properties, surface tension and viscosity, loss on drying, ash value and swelling index. The result showed that extracted *Opuntia stricta* mucilage exhibited good flow properties (Angle of repose 25.30°), the surface tension of 2.85% w/v solutions of mucilage was found to be 70.20 N/m, total ash was 28.33% w/w, loss on drying was 13% and pH was found to be in the range of 7.2-7.4. Extracted mucilage was soluble in warm water and slightly soluble in cold water while insoluble in organic solvents except chloroform. Phytochemical screening and powder characteristics of extracted mucilage powder of *Opuntia stricta* cladodes showed that it can be safely used in dosage form without causing any adverse effect.

1. Introduction

Natural polymers are commonly obtained from plant sources. They are high molecular weight; water soluble polymers made up of monosaccharide unit and joined by glycosidic bond. Gummy excaudate of natural polymers such as protein, enzyme, muscle, fibers, polysaccharide have been used to formulate various pharmaceutical products. The well-known natural polymers are aloe mucilage, guar gum, karaya gum, bhara gum, okra gum and linseed mucilage. Mucilage is a complex carbohydrate.[1–6] These natural polymers are used in formulation of different pharmaceutical dosage forms like matrix controlled system, sustained release drugs, microsphere, nanoparticle, buccal film and viscous liquid formulation. The specific application of natural polysaccharide in pharmaceutical preparations is to aid in the processing of the drug delivery system during its manufacture, its protection, its stability, its bioavailability and its patient acceptance. Gum has obtained from hydrocolloids of plant and can be classified into two groups' i.e. anionic and non-ionic polysaccharides. Hence by modification gum can alter their physicochemical properties. Mucilage is a metabolized product which is intracellularly formed without injury to the plant. Gums are readily soluble in water while mucilage forms slimy mass in the presence of water. Gum and mucus are translucent and amorphous substances that plants produce as protection against injury. The rubber has various pharmaceutical

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applications such as suspending agents for solid insoluble components in the mixture, emulsifier for resin oil and adhesive in troche masses and tablets. They can be used as a thickener, emulsifier, sweetener, viscosity enhancer in pharmaceutical preparations.[7–12] The natural polymers are applicable in the households, agriculture, food industries and in packaging and it help in decreasing the environmental pollution and resulting in disposal in landfills. Natural polymers are used as an environment cleaner, renewable and also help in recycling of global carbon. Mucilage obtained from the Cladodes of Opuntia stricta, is a polysaccharide consists of D-galactose, L- rhamnose and L-galactouronicacid.[13]

2. Materials and Methods

2.1. Extraction Procedure

Cactus (*Opuntia stricta*) cladodes were obtained from rural areas of Kolhapur District, India. Collected cactus cladodes were carefully washed and dried under shade for 24 hours, further spines were cut properly by knife. Whitish mucilaginous core was separated from cladodes and then it is used for mucilage extraction. Extraction of mucilage includes following steps.[14]

1. **Step1:** Extraction of mucilage: Separation of whitish mucilaginous core from cladodes. Whitish core was grinded in grinder, and then filtrated through filter paper. If filtrate contains some chlorophyll pigments then again it was filtrated using activated charcoal filtration method. Whitish filtrate was then used for isolation of mucilage.
2. **Step2:** Isolation of mucilage: Acetone was added to filtrate in proportion of 3:2 to precipitate the mucilage, the mucilage was separated, dried in oven at about 45^0C, powdered and passed through sieve #80. The powdered mucilage was stored in desiccators until further use.

2.2. Physicochemical characterization of isolated mucilage

2.3. Phytochemical screening

Aqueous solution of extracted mucilage was used for chemical characterization. Test for carbohydrates, proteins, mucilage, alkaloids, amino acids, gums were performing according to standard procedure[15]

2.4. Organoleptic evaluation of isolated mucilage

The isolated mucilage powder was characterized for organoleptic properties such as color, odor, taste, fracture and texture[16]

2.5. Solubility behavior of mucilage

One part of dry mucilage powder was shaken with different solvents and the solubility was determined.[16]

2.6. pH of mucilage

The mucilage was weighed and dissolved in water separately to get 1% w/v solution. The pH of solution was determined using digital pH meter.

2.7. Swelling index of isolated mucilage

The swelling index is the volume (in mL) taken up by the swelling of 1gm taste material under specified condition. The swelling index of the mucilage was determined by accurately weighing 1gm of mucilage powder which was further introduced into 25mL of glass stoppered measuring cylinder. 10mL of water was added in mucilage powder. After proper shaking it was then allowed to stand for 24 hours at room temperature, in between it was shaken after every 3 hours. The volume occupied by mucilage was measured. Also the weight of swollen mucilage was measured .Swelling power and solubility of mucilage in water was then calculated using following formulas.[17]

$$\text{Swelling index [g/g mucilage]} = msw / (mo\text{-}ms)$$
$$\text{Solubility [g/100g mucilage]} = [ms / mo] \times 100\ \%$$

Where, msw is weight of swollen mucilage, mo is sample weight and ms is weight of dried supernatant.

2.8. Surface tension

1gm of mucilage powder was dissolved in 30mL water and placed in sonicator for 20 minutes for proper dissolution. Then surface tension of the mucilage solution was determined by drop count method, using Ostwald's stalagmometer. The surface tension of the polymer has been reported to influence the binding quality of the polymer.

2.9. Viscosity

The viscosity of mucilage sample was determined using same sample which is used in determination of surface tension. Method used was time of flow of sample through Ostwald's viscometer.

2.10. Loss on drying

The test was carried out according to the procedure. One gram of powder was weighed accurately in a weighing bottle and was dried in a hot air oven at 105°C and the weight was checked at intervals of 10min, until a constant weight was obtained.[17] The percentage of weight lost by the powder was calculated using equation,

Loss on drying = *(Initial weight − final weight) / (Initial weight)*

2.11. Ash value

1gm of sample was used to measure ash value. Sample was placed in crucible and by using Muffle furnace equipment by keeping sample at 4500 C for 3 hours. [18]

Total ash value = (Weight of ash / Weight of polymer) ×100

Acidinsoluble ash = (Weight of acidinsoluble ash/ Weight of dried powder) ×100

Water soluble ash = (Weight of water-soluble ash/Weight of dried powder) ×100

3. Bulk Density and Bulkiness

It has been described that inverse of bulk density is called as bulkiness. As per previous study accurately weighed quantity of (5 g) was introduced into a graduated measuring cylinder. The cylinder was fixed on the bulk density apparatus and the volume occupied by the powder was noted. Then, the powder was subjected to tapping in a bulk density apparatus until constantvolume was obtained. The final volume (Bulk volume) was noted. Bulk density, tapped density and bulkiness were calculated using equations. [19]

Bulk density =Weight of mucilage powder / Weight of apparent volume

Tapped density= Weight of mucilage powder/Tapped volume

Bulkiness =1/ Bulk density

4. Powder Flow Property

Flow characteristics were measured by angle of repose. Using the readings and the formula, the angle of repose was calculated using equation,

$$Tan\,\Theta = h/r$$

Where,

Ø= Angle of repose, h = Height of pile, r = Radius of pile

5. Results and discussion

After extraction and further precipitation by use of acetone, the yield of mucilage was found to be 1.44% w/w. The isolated sample was subjected to identification; this showed presence of carbohydrates in sample powder. Confirmation of mucilage was done when it gave negative test for tannins, alkaloids and proteins. This can be considered as proof for purity of the isolated mucilage as described in Table 1.

The results for loss of drying showed value of 13 %. This indicated that mucilage is hygroscopic in nature and need to be stored in air-tight containers. In solubility behavior of Opuntia stricta mucilage was found to be soluble in warm water, slightly soluble in cold water and insoluble in organic solvents except chloroform. Surface tension of 2.85 % w/v solutions of mucilage was found to be 70.20 N/m. Viscosity of same sample was found to be 1.13 cP. Carbohydrates, Non reducing polysaccharide were present and other phyto-constituents were absent in the isolated powder of mucilage. pH of 1% solution was found to be in between the range of 7.2-7.4. Organoleptic characters show that mucilage powder is brownish color, odorless, tasteless, rough and irregular in shape. Ash values were calculated to characterize mucilage; total ash, acid insoluble ash and water soluble ash were found 28.33 %, 20 % and 19 % respectively. Physical characterization of mucilage was carried out for bulk density and bulkiness, true density, powder flow behavior. Result obtained in micromeritic characterization of mucilage was shown in Table 2. The swelling index and solubility of isolated mucilage sample was found to be 6.94 and 34 % respectively.

Table 1: Determination of purity of isolated mucilage

Sr. No	Test	Present(+)/absent(-)
1	Carbohydrates	+
2	Non reducing polysaccharide	+
3	Monosaccharides	-
4	Proteins	-
5	Fats and oils	-
6	Tannins and Phenolic Compounds	-
7	Alkaloides	-
8	Amino acids	-
9	Mucilage	+
10	Gums	-

Table 2: Micromeritic study data of mucilage

Sr. No	Parameters	Values
1	Angle of repose (o)	25.30
2	Carr's index (%)	19.22
3	Tap density (gm/ml)	0.71
4	Bulk density (gm/ml)	0.57
5	Hausner's ratio	1.23

6. Conclusion

Mucilage of the cactus species Opuntia stricta was extracted and characterized. Characterization of the isolated mucilage powder has shown well expected results in properties such as bulk density, tapped density, solubility, swelling index, hausner's ratio, carr's index, angle of repose, tap density

and bulk density. Results of evaluated parameters showed that Opuntia stricta mucilage can be used as pharmaceutical excipient to formulate solid oral dosage form. They can be used as a thickener, emulsifier, sweetener, viscosity enhancer in pharmaceutical preparations. It has acceptable pH and organoleptic properties, so can be easily used to formulate various dosage form.

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8. Conflict of Interest

None.

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