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Research article

Extraction and physicochemical characterization of *Basella alba L* fruit mucilage and its comparative study

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Abstract

The revival of interest in natural products started in last decade due to the wide spread belief that they are healthier than synthetic product. Mucilages are the most commonly used pharmaceutical aid in pharmaceutical preparations. The ethno medicinal plant *Basella alba* L. belongs to the family Basellaceae, is a type of tropical herb which has been used for its medicinal benefits and is also known to contain complex polysaccharide called mucilage. In the present research work, mucilage was extracted from the fruit of *Basella alba* L. It was isolated using solvent precipitation method and characterized for its morphological properties and various identification tests were carried out. The dried fruits were reported to contain 4% w/w of mucilage whereas the fresh fruits contain 0.8% w/w of mucilage. Various physicochemical properties viz solubility, swelling index, melting range and pH of mucilage were studied. Some of the pharmaceutical properties of mucilage like powder flow property, compressibility index, angle of repose, bulk density were also studied. The water holding capacity and flow property of the mucilage from dry fruits was found to be better than that from fresh fruits. However solubility and pH of both the mucilages were found to be similar. The results indicate that mucilage obtained from the dried fruits of *Basella alba* has better qualities to be used as pharmaceutical excipient.

Introduction

Recently the trend toward use of the vegetable and nontoxic products have increased which led to higher demand of natural product replacing the synthetic excipients. Being a natural product of non toxic nature, application of mucilage is growing significantly in industry due to its low cost, ease of availability and appropriate quality [1]. Natural gums and mucilages possess a wide range of pharmaceutical properties, which make them useful as additives in pharmaceutical preparations. So it has become essential to find out the newer source of plant mucilage to meet industrial demand. Mucilages are polysaccharide complexes composed of sugar and uronic acid units which are not soluble in alcohol but dissolve or swell in water [2]. So they can be isolated by dissolving in alcohol. Due to presence of hydrophilic molecules, they combine with water, swell and form viscous solution or gel. Mucilage is formed within the cell and is normal product of metabolism, which are produced without injury to the plant [3-4]. They are complex polysaccharides which consist of arabinose, galactose, rhamnose and galacturonic acid and form large molecular aggregates in solution. The uronic acid can form salts with magnesium, calcium and sulfate ester substituents. Mucilages due to its versatile excipient property are mostly used in pharmaceutical industries. It has wide range of applications as tablet binders, disintegrating, suspending, emulsifying, gelling, thickening, stabilizing, and film forming agents. It can also be used to control the release of drug in sustained drug delivery system as well as act as cytoprotective agent in the treatment of ulcer [5].

Basella alba L. with the synonym Basella rubra Roxb. belonging to the family Basellaceae, is a fast growing perennial vine and extremely heat tolerant [6]. It is also known as Malabar spinach, Ceylon spinach, Indian spinach, vine spinach, Chinese spinach. Basella is mainly found in tropical Southern Asia, probably originated from India or Indonesia [6]. The fruit of Basella alba is fleshy, stalk less, 5-6 mm long, ovoid or spherical in shape and contains one seed only and changes to purple colour when matures. The fruit contains β-cyanin, gomphrenin I, gomphrenin II, and gomphrenin III [7-8]. The plant is a rich source of nutrients and minerals [7]. It has various medicinal and cosmetic applications. It is a secondary metabolite storage and act as food reservoir which help in water retention and germination [9]. The mucilage isolated from the plant has wider applications as pharmaceutical aid. The leaves and stem of Basella alba L contain a high proportion of mucilage and is being used as adjuvant in different pharmaceutical dosage form. But there are no reports on isolation and characterization of mucilage from the fruits only. Hence, the present study is

concerned with the extraction, isolation and characterization of mucilages from the fruits of Basella alba L and envisages a comparison of the mucilage obtained from fresh fruits and dry fruits.

Figure 1. ***Basella alba*** **fruits.**

Experimental

Materials

Fresh fruits of *Basella alba* were procured from local market (Grocery shop). The plant along with the fruits were authenticated by Botanical Survey of India, Central National Herbarium, AJC Bose Indian Botanic garden, Howrah, Kolkata (Specimen no:MC0105). All other chemicals were of analytical grade and obtained commercially and used as received.

Method

Basella alba fruits were used for isolation of mucilage. The collected fruits of *Basella alba* were cleaned, washed with water to remove dirt. Both fresh and dry fruits were used for mucilage isolation. Fresh fruits were crushed into in a mixer and used. Dry fruits were obtained by drying under shade for three days and then dried at 35°C until constant weight was obtained. Its size was reduced through grinder [10]. The grinded fruit was passed through sieve no 18 and stored in air tight container for further use. Extraction of mucilage was done from plant material by following the two steps.

Step 1. Extraction of mucilage

Mucilage was extracted by soaking the crushed fruits of *Basella alba* with distilled water taking four times its weight of water and then kept overnight. Viscous solution was obtained which was passed through the muslin cloth to seperate the residue. The material was then squeezed in the muslin cloth and marc was removed from the filtrate. The same procedure was followed for dry fruits.

Step 2. Isolation of mucilage

Equal volume of acetone was taken and added to the filtrate to precipitate out the mucilage. The precipitated mucilage was separated and washed with acetone thrice to remove any trace of water. The separated mucilage was then dried in oven at about 40ºC for few hours and then air dried, powdered and passed through sieve no. 80. The powdered mucilage was then stored in desiccator until further use [11]. The yield of mucilage was calculated as:

$$\boldsymbol{Yield}(\%) = \frac{\boldsymbol{Weight\ of\ dried\ powdered\ mucilage}}{\boldsymbol{Weight\ \ of\ B.alba\ fruits}} \times \mathbf{100}$$

Physical characterization of mucilage

The isolated mucilage was evaluated for physical properties such as color, odor and appearance.

Physicochemical characterization of mucilage

Solubility

Solubility of the isolated mucilage was determined by shaking with various solvents such as acetone, chloroform, ethanol, hot and cold water.

pH

Required amount of mucilage was weighed and dissolved in water to prepare 1% w/v solution. Digital pH meter was used to check the pH of the solution [12].

Swelling index

The swelling index is defined as the volume (in ml) which is taken up by swelling of 1 g of test material under specified conditions [12]. The swelling index of isolated mucilage was found by weighing 1g of powdered mucilage accurately, which was then taken in a 25ml glass-stoppered measuring cylinder. Then 25ml of distilled water was added to it and shaken gently. The mixture was then left undisturbed for 24 hrs at room temperature. The volume occupied by swelling of mucilage, was measured. The same process was repeated three times and the average was found.

$$\boldsymbol{Swelling\ Index\ (SI)} = \frac{\boldsymbol{Final\ volume - Initial\ volume}}{\boldsymbol{Initial\ volume}} \times \mathbf{100}$$

Water holding capacity

0.25g of sample was accurately weighed and taken in beaker and added with 25 ml of distilled water. It was mixed in a magnetic stirrer for 15 min, and centrifuged at 10000xg for 30 min. Then the supernatant was removed and wet samples were weighed. The water holding capacity was obtained by the following equation [13]:

$$\boldsymbol{Water\ Holding\ capacity}\ \ (\boldsymbol{g\ water/g\ dry\ sample\ weight})$$

$$= \frac{\boldsymbol{Wet\ sample\ weight - Dry\ sample\ weight}}{\boldsymbol{Dry\ Sample\ weight}}$$

Loss on drying

1.0 g of mucilage was taken in a petridish and then dried in an oven till a constant weight was obtained. The percentage loss on drying was obtained from the formula and expressed as a percentage [14].

$$\textbf{LOD}\ (\%) = \frac{\textbf{Weight of water in sample}}{\textbf{Weight of dry sample}} \times \textbf{100}$$

Pharmaceutical characterization of mucilage

Preparation of granules

Granules were prepared following wet granulation technique using 20% w/w of *Basella alba* fruit mucilage, starch and lactose. It was then dried in hot air oven at a temperature of 40°C and passed through sieve no 22.

Evaluation of granules

The prepared granules were used to evaluate the following parameters

Bulk density and bulkiness

25g of the prepared granules were taken in a graduated measuring cylinder. The volume occupied by the granules was measured and the cylinder was placed on the bulk density apparatus. Then, the granules were tapped using the bulk density apparatus until a constant volume was recorded. Then finally tapped volume was noted [15]. Bulkiness is the inverse of bulk density.

$$\textbf{Bulk density} = \frac{\textbf{mass of granules}}{\textbf{untapped volume}}\ \textbf{Tapped density} = \frac{\textbf{mass of granules}}{\textbf{tapped volume}}$$

Powder flow property

The flow property of the granules was measured by angle of repose. 10g of the prepared granules were accurately weighed and poured into a funnel attached to a stand with its tip 10 cm above from the surface of paper blocking the tip of the funnel. The granules were then allowed to flow freely on the paper surface. After complete flow of granules, the radius of the cone (R) formed and the height of the cone (H) formed were measured and angle of repose was calculated. The experiment was repeated thrice [15].

$$\textbf{Angle of repose} = \textbf{Tan}^{-1}\textbf{(H/R)}$$

Powder compressibility

5g of powdered mucilage was taken in a measuring cylinder attached to bulk density apparatus and tapped. The parameters were calculated using the formula [16].

$$\textbf{Carr's Index} = \frac{(\textbf{Tapped density} - \textbf{Bulk density})}{\textbf{Tapped density}} \times \textbf{100}$$

Hausner ratio

Hausner ratio is calculated from the values of tapped density and bulk density and it indicates the flowability of a powdered material [15].

$$\textbf{Hausner ratio} = \frac{\textbf{Tapped density}}{\textbf{Bulk density}}$$

Figure 2. *B. alba* fruit mucilage.

Table 1. Identification tests of mucilage obtained from both fresh and dry fruits.

S. No.	Identification Tests [17,18,19]	Observation
1	Mounted in 95% ethanol	Transparent angular masses
2	Mounted in ruthenium red	Particles stained red
3	Mounted in Iodine solution.	Particles stained blue
4	Mucilage +Methylene blue	Deep blue
5	Mucilage + Aqueous Potassium hydroxide solution	Swelling of mucilage
6	Powder+ Iodine sol.+ Zinc chloride	Violet
7	Test for Carbohydrates (Molisch's test)	Purple colour
8	Warming with 5M Sodium hydroxide solution	Brown colour

Table 2. Comparison of Organoleptic and physicochemical characterization of mucilage.

Sl. No.	Parameter	Result	
		Fresh fruits	Dried fruits
1	Colour	Brownish	Brownish
2	Odour	Characteristic	Characteristic
3	Percentage yield	0.8±1.3	4±1.8
4	pH	6.7±0.9	6.7±0.8
5	Swelling index (%)	11.8±1.3	13.4±0.9
6	Melting point (ºC)	245±0.05	245±0.07
7	Water holding capacity (g water/g dry sample wt)	0.8±1.1	1.2±1.6
8	Loss on drying (%)	6.8±0.4	7.0±0.5

Table 3. Solubility profile of mucilage obtained from both fresh and dry fruits.

Solvent	Solubility
Cold water	Swell to form gel
Hot water	Soluble
Benzene	Insoluble
Acetone	Insoluble
Ethanol	Insoluble

Table 4. Comparison of Micromeritic properties of mucilage.

Sl. No.	Parameter	Result	
		Fresh fruits	Dried fruits
1	Bulk density (g/cc)	0.35±0.4	0.44±0.16
2	Tapped density (g/cc)	0.47±0.8	0.52±0.04
3	Angle of repose (º)	31.50±0.02	27.25±0.01
4	Compressibility index (%)	15±0.58	10.38±0.1
5	Hausner's ratio	1.20±0.2	1.12±0.5

Result and discussion

The yield of mucilage from fresh fruits of *Basella alba* was found to be 0.8% w/w and from dried fruits the yield of mucilage was found to be 4% w/w respectively. This indicates that the dried fruits are better than fresh fruits for getting good yield of mucilage. The results of identification tests of the isolated mucilage are same for both fresh and dry fruits. The identification of carbohydrate in the isolated mucilage was confirmed with the positive result of Molisch's test (purple color formation) and Ruthenium red test (formation of pink color) respectively. Mucilage with iodine solution and methylene blue stained the particles blue. The results confirmed the sample as mucilage. All the evaluation parameters for mucilage were found to be within the acceptable limit. A 1% w/v solution of mucilage in water showed a pH of 6.7, which is near to the neutral pH. The morphological and physical evaluatory studies of isolated mucilage from both fresh and dry fruits are found to be same, it shows brownish powder, with characteristic odor. When dissolved in water, it gives neutral, colloidal solution; it is soluble in warm water, practically insoluble in ethanol, acetone, ether and chloroform. Moisture content of mucilage was found to be 7 % which was found to be within the official limit. Mucilage decomposes above 2000c, which is a characteristic of most of the polysaccharide. The swelling index was found to be 13.4. The water holding capacity of dry fruit mucilage was found to be better than that of fresh fruits. The results of swelling index and water holding capacity indicate that B. alba mucilage can be used in novel drug delivery system to control the release of drug from the dosage form. However solubility and pH of both the mucilages were found to be similar. Higher bulk density of dried fruits mucilage as compared to fresh fruits mucilage showed less number of void space in dried fruit mucilage. The value of angle of repose and compressibility index indicates that the flow property of mucilage obtained from dried fruits was excellent whereas mucilage from fresh fruits was good.

Conclusion

Basella alba plant is commonly available, the leaf and stem of the plant is known for its edible property but the fruits are not much used. So *B.alba* fruits were utilized for extracting mucilage. From the present study, it can be seen that the percentage yield of mucilage obtained from dry fruits of *Basella alba* is much better than the fresh fruits. The extracted mucilage shows good physicochemical and micromeritic properties exhibiting better excipient property. The mucilage obtained from dried *Basella alba* fruits showed very good flow properties. Thus, the results show that they have the potential to be used as additives in different pharmaceutical formulation.

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References

1. Malviya R., Srivastava P., Kulkarni G. T: Applications of Mucilages in Drug Delivery – A Review. Advances in Biological Research 2011; 5 (1): 1–7.
2. Evans WC. Trease and Evan's Pharmacognosy. London: WB Saunders Company; 14th ed. 2001. p. 210.
3. Rathee S, Ahuja D, Rathee P, Thanki M, Rathee D: Cytotoxic and antibacterial activity of Basella alba whole plant: A relatively unexplored plant. Pharmacologyonline 2010; 3: 651-658.
4. Jani Girish K, Shah, Dhiren P, Prajapati Vipul D, Jain Vineet C: Gums and mucilages: versatile excipients for pharmaceutical formulations. Asian Journal of Pharmaceutical Sciences 2009; 4 (5): 308-322
5. Chowdhury Moumita, Sengupta Abhijit, Datta Lopamudra, Chatterjee Sumana: Role of mucilage as pharmaceutical additives and cytoprotective agent. Journal of Innovations in Pharmaceutical and Biological Sciences 2017; 4 (2): 46-52
6. Deore, S.L. and S.S. Khadabadi: Standardisation and pharmaceutical evaluation of Chlorophytum borivilianum mucilage. Rasayan J. Chem. 2008; 1: 887-892.
7. Dr.Gyandendra Pandey: Dravyaguna Vijnana, Varanasi. Krishnadas Academy 2003; 3: 728-32
8. Singh Manju, Singh Rajeshwari & kotecha, Mita: Basella rubra Linn. – A Review. International Journal of Ayurveda and Pharmaceutical Chemistry 2016; 5: 206-223.
9. Chuennapa Chatchawal, Natsajee Nualkaew, Srisomporn Preeprame, Supatra Porasuphatana, Aroonsri Priprame: Physical and Biological Properties of Mucilage from Basella alba L. Stem and Its Gel Formulation. IJPS 2010; 6(3): 104-112
10. Saroj V, Rao PS, Rao SK, Krunal S: Pharmacognostical study of Basella alba stem. International Journal of Research in Pharmaceutical and Biological Sciences 2012; 3: 1093-1094.
11. Malviya R., Srivastava P., Bansal M., Sharma P. K.: Mango Peel Pectin as Superdisintegrating Agents. Journal of Scientific and Industrial Research 2010; 69: 688–690.
12. Lala P. K.: Practical Pharmacognosy. Calcutta, Lina Guha, (1981), 135.
13. Thanatcha,R. and Pranee,A: Extraction and characterization of mucilage in Ziziphus mauritiana Lam. International Food Research Journal 2011; 18: 201-212

14. Bhat Vishnu , Nayak Ravikumar, Praveena M.B: Isolation and evaluation of Disintegrating properties of Basella alba Linn. leaf mucilage in Tablet formulations. Journal of Biomedical and Pharmaceutical Research 2015; 4(2): 29-42
15. Gordon, R.E., Rashanke, T.W., Fonner, D.E., Anderson, N.R. and Banker, G.S., In: Lachman, L., Lieberman, H.A. and Schwartz, J.B. Eds., Pharmaceutical Dosage forms:Tablets, Vol.2, Marcel Decker, New York, 1999,245.
16. Srivastava P., Malviya R.: Extraction, Characterization and Evaluation of Orange Peel Waste Derived Pectin as a Pharmaceutical Excipient. The Natural Products Journal 2011; 1(1): 65-70
17. C. A. Alalor, J. A. Avbunudiogba, K. Augustine: Isolation and characterization of mucilage obtained from Colocasia. IJPBS 2014; 4(1): 25-29
18. Uzma Farooq, Rishabha Malviya and Pramod Kumar Sharma: Extraction and Characterization of Okra Mucilage as Pharmaceutical Excipient. Academic Journal of Plant Sciences 2013; 6 (4): 168-172
19. Divekar Varsha B., Kalaskar Mohan.G, Chougule Poonam D. , Redasani Vivek K. and Baheti D.: Isolation and characterization of mucilage from Lepidium sativum Linn. Seeds. International Journal of Pharma Research and Development 2006; 2(1): 1-5.