ORIGINAL ARTICLE

Isolation and characterisation of *Cardiospermum halicacabum* mucilage

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Cardiospermum halicacabum is an edible plant rich in mucilage, which belongs to the family Sapindaceae. Although the plant has been used traditionally, there is no report on isolation and characterisation of mucilage from *C. halicacabum*. The present work was aimed to isolate and characterise the mucilage from the aerial parts of *C. halicacabum*. The isolated mucilage was characterised for physical, chemical and flow properties. The mucilage was further characterised by Fourier transform infrared (FTIR) spectroscopy. The isolated mucilage had good physical, chemical and flow properties. The FTIR spectrum of mucilage showed characteristic peaks. It was concluded that the *C. halicacabum* mucilage can be used as an excipient in pharmaceutical formulations.

Key words: *Cardiospermum halicacabum*, characterisation, isolation, mucilage

INTRODUCTION

Modern science and technology can be used to make herbal medicines into patient complaint dosage forms. Present day consumers are attracted much by natural ingredients in food, drugs and cosmetics as it is believed that natural substances will be more safe and devoid of side effects.[1] Recent researchers have combined inert cell inclusions like natural mucilage, resin, gum along with allopathic medicine for coating or for achieving various advantages such as improved stability, dose reduction, taste masking, aesthetic appeal, extended or controlled release of herbs, reduced toxicity or to enhance bioavailability of drugs.[2] Plant products work as a substitute to synthetic products because of local availability, low price and biodegradable properties. Many plants are rich in mucilage like Isapgol, guar gum, Aloes, Acacia, *Hibiscus esculentus*, *Hibiscus rosasinensis*, Karaya gum, etc.[3,4] *Cardiospermum halicacabum* has been widely used as an antiarthritic agent, belongs to the family Sapindaceae, commonly known as Balloon vine, Mudukkottan in Tamil.[5,6] The aerial parts of *C. halicacabum* contain mucilage. The present study focuses on the isolation and characterisation of the mucilage from *C. halicacabum*. The data so obtained can be used as a standardizing parameter for future research work.

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MATERIALS AND METHODS

Materials

Fresh plant parts of *C. halicacabum* were collected from in and around Chennai, Tamil Nadu, India.

Isolation of the mucilage[3]

Aerial parts of the plant were collected, washed and shade dried. Dried plant parts were ground in a domestic mixer and was soaked in water for 5–6 h, boiled for 30 min and left to stand for 1 h to allow complete release of the mucilage into the water. The mucilage was extracted using a multi-layer muslin cloth bag to remove the marc from the solution. Acetone was added (three times the volume of filtrate) to precipitate the mucilage. The mucilage was separated, dried in an oven at a temperature of less than 50°C, collected, ground, passed through #80, weighed to calculate the yield and stored in desiccator till use.

Purification of the Mucilage

The crude mucilage (1%) was homogenised with 5% cold dilute trichloro acetic acid solution. The solution was centrifuged at 3500 rpm for 20 min, neutralized with sodium hydroxide by drop wise addition and then dialysed against distilled water. The mucilage was precipitated with ethanol (three times the volume) and washed successively with ethanol, acetone and diethyl ether. The mucilage obtained was dried under vacuum (less than 1 Torr at 25°C for 12 h). Then it was passed through a # 80 sieve and stored in desiccator till use.

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Physicochemical Characterisation of Mucilage

Physical characterisation[7-12]

The dried mucilage was studied for percentage yield, chemical test, particle size, loss on drying, solubility, viscosity, pH, swelling index and flow properties.

Percentage Yield

Dried mucilage was weighed and the percentage yield was calculated.

Weight Loss on Drying

Weight loss on drying was determined for an appropriate quantity of mucilage at 105°C for 2 h.

Particle Size

The particle size of *C. halicacabum* mucilage was determined by microscopic method.

pH of the Solution

pH of percentage solution was measured with pH meter.

Density

A 0.5%w/v solution of dried mucilage was prepared and transferred to a density measurable bottle. An empty bottle with distilled water was weighed. The density of the dried mucilage was calculated.

Charring

A few milligram of dried mucilage was placed in melting point apparatus. The temperature was recorded when the material started to melt and char.

Swelling Ratio

A 100 ml stoppered graduated cylinder was filled with 1 g of dried mucilage. The initial bulk volume of 1 g of dried mucilage was recorded. Water was added in sufficient quantity to yield 100 ml of uniform dispersion. The sediment volume of the swollen mass was measured after 24 h, stand at room temperature. The swelling ratio was calculated by taking the ratio of the swollen volume to the bulk volume.

Solubility

The solubility of the mucilage of *C. halicacabum* was determined in common solvents such as water, acetone, ethyl alcohol, ether and toluene.

Flow Properties

The dried mucilage of *C. halicacabum* was tested for the flow properties such as angle of repose, bulk densities, compressibility index and Hausner's ratio. All these evaluations were carried out in triplicate as per procedures described in official books.

Rheological Studies

Viscosity

Viscosity measurements of mucilage were carried out using 1% (w/v) solution of freshly prepared mucilage solution in distilled water.

Total ash

Total ash was determined by placing 3 gm of mucilage in a crucible, the material was spread as an even layer and ignited by gradually increasing the temperature to 550°C until it is white, indicating the absence of carbon. The crucible was cooled in a desiccator, weighed and the content of total ash in mg/g of air dried material was calculated.

Acid insoluble ash

Acid insoluble ash was determined by boiling the ash with 25 ml of dilute hydrochloric acid for 5 min and then filtered through an ashless filter paper. The filter paper was the ignited in the silica crucible, cooled and weighed.

Fourier transform infrared spectroscopy

Fourier transform infrared (FTIR) spectrums of dried mucilage were recorded on samples prepared in potassium bromide disks using FTIR spectrophotometer (JASCO 4100, Japan). Samples were prepared in KBr disks. The scanning range was 500–4000/cm.

Table 1. Chemical properties of the mucilage

Chemical properties	Observation
Mucilage mounted with water	Swells and forms mucilaginous mass
Mucilage mounted with ruthenium red	Particles stained pink colour
Mucilage mounted with corallin soda	Particles stained pink colour
Mucilage mounted with iodine solution	Particles stained blue colour
Mollish test (for carbohydrates)	+ve
Ferric chloride test (for tannins)	-ve
Silver nitrate test (for chlorides)	-ve
Barium chloride test (for sulphates)	-ve

Table 2. Physical properties of the mucilage

Physical properties	Observation
Average particle size	191.32±1.75 µm
Loss on drying	2.51±0.34
Swelling ratio	23.26±0.814%
pH	7.6±0.1
Charring	242.3±2.516°C
Density	1.076±0.016 g/ml

Table 3: Flow properties of the mucilage

Flow properties	Observation
Bulk density (g/ml)	0.2612±0.0364
Tapped density (g/ml)	0.2730±0.0186
Compressibility index (%)	23.48±0.0450
Hausner's ratio	1.3060±0.0155
Angle of repose (θ°)	23.44±0.02

Table 4: FTIR spectral data of *C.halicacabum* mucilage

Absorption peak value	Absorption range	Type of bond
3466.42	3200–3400	N–H (amine, symmetrical or asymmetrical) O-H (hydrogen bond, intramolecular)
3435.56	3200–3400	N–H (amine) O–H (hydrogen bond, intramlecular)
3392.17	3200–3400	O–H (hydrogen bond, intermolecular, polymeric association)
3377.71	3200–3400	O–H (hydrogen bond, intermolecular, polymeric association)
3349.75	3200–3400	O–H (hydrogen bond, intermolecular, polymeric association) N–H (aminoacid)
2356.59	2100–2660	C≡C (alkynes)
1636.3	1650–1500	N–H (bending)
1619.91	1650–1500	N–H (bending)
1609.31	1650–1500	N–H (bending)
1593.88	1650–1500	N–H (bending)
1584.24	1600–1450	C=C (aromatic)
641.21	600–1500	C=C (alkenes)

Chemical characterisation

The extracted mucilage was tested for chemical characteristics for identification, test for carbohydrates, Tannins, chlorides, sulphates and uronic acid.

RESULTS AND DISCUSSION

Physicochemical Properties

The percentage yield of mucilage isolated from *C. halicacabum* was found to be 2.5%, soluble in water and insoluble in acetone, ethyl alcohol, ethyl acetate and toluene.

Chemical Properties

The mucilage gave positive results for carbohydrates and uronic acid and negative results for tannins, chlorides and sulphates [Table 1].

Physical Properties

The average particle size of dried mucilage was 191.32±1.75 µm. The average particle size of dried mucilage was found to be uniform. The weight loss on drying was 2.51±0.34% and the percentage of swelling was 23.26±0.814%. The dried mucilage was melted and charred at 242.3±2.516°C. The density of 1.0% (w/v) solution was 1.076±0.016 g/ml and a pH of 7.6±0.1 [Table 2].

Flow Properties

The bulk density and tapped density values of the dried mucilage were 0.2612±0.03640 and 0.2730±0.0186 g/ml, respectively. The compressibility index of the dried mucilage was 23.48±0.0450% and Hausner's ratio was found to be 1.3060±0.0155. Thus, the flow of the dried mucilage was good. The Angle of Repose of the mucilage was 23.44±0.02°. These data revealed that the mucilage can be used as binder in tablet formulations and other pharmaceutical formulations [Table 3].

Rheological Properties

The viscosity if the dried mucilage was found to be 1.249±0.0171 poise.

Total Ash

The total ash value of the dried *C. halicacabum* mucilage was found to be 42.163±2.102.

Acid Insoluble Ash

The acid insoluble ash value of the dried *C. halicacabum* mucilage was found to be 4.036±0.092.

Fourier Transform Infrared Spectroscopy [Table 4].[13,14]

CONCLUSION

The main objective of the work was to isolate the mucilage from *C. halicacabum* plant and to characterise the same. Natural material being chemically inert, nontoxic, biocompatible with good physicochemical and flow properties, the isolated mucilage can be effectively used as an excipient in pharmaceutical formulations.

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