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Mucilage: A Rich Source of Excipients Present in Plant Parts with Gold Status

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Abstract

Large numbers of pharmaceutical excipients of natural origin are available nowadays. Plant materials like mucilages with a variety of pharmaceutical applications are most common. They are being used due to their abundance, safety, compatibility, cost-effectiveness and eco-friendly nature as compared to synthetic one and have various advantages over synthetic polymers. To compete with and replace artificial excipients mucilages can be modified in many ways to obtain the required form of a drug delivery system. Currently, there are a vast amount of natural pharmaceutical excipients are there, and due to its increasing demand, it has become essential to identify or explore more plant mucilage sources to fulfil the industrial need. Mucilages are polymeric mono-saccharides or mixed mono-saccharides combined with uronic acids. On hydrolysis, they yield a mixture of sugars and uronic acids, and the mucilages that are obtained from plant sources have translucent and amorphous nature. Due to presence of hydrophilic moieties in mucilages, they can easily combine with water to form a gel or a thick viscous solution, and these extracted mucilages from the plant can be processed to a certain extent and incorporated in dosage forms to achieve the specific performance of the formulation. In this review, we describe isolation, characterization, pharmaceutical application and methods of modification to develop drug delivery systems.

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INTRODUCTION

Use of Mucilage in drug delivery systems and dosage forms helps in modifying the release of drug from its dosage forms, enhancement of solubility, bioavailability, patient acceptability and also ensures ease of manufacture (Raymond *et al.*, 2006; Patel *et al.*, 2007). These materials of natural origin like mucilages are cheap, safe, readily available, eco-friendly, degradable, stable & compatible due to its natural source and capable of modification, they are seeking a lot of attention and importance in the field of delivery of drugs (Malviya *et al.*, 2011). These excipients of natural origin have replaced the synthetic excipients, and recently there is increased use of natural and non-toxic products. Currently, huge amounts of pharmaceutical excipients of natural origin are available and like other products of natural origin and due to its increasing demand it has become essential to identify or explore more

plant mucilage sources to fulfil the industrial need. These mucilages obtained from plant sources are the hydrocolloids of Polysaccharides having sugar molecules & uronic acids that are liked with each other.

They are polymeric mono-saccharides or mixed mono-saccharides combined with uronic acids and on their hydrolysis produce a mixture of sugars and uronic acids. The mucilages that are obtained from plant sources are translucent and amorphous.

Due to the presence of hydrophilic moieties in mucilages, they can easily combine with water to form a gel or a thick viscous solution. Mucilages form large molecular aggregates in solution, and these mucilages are made up of complexes of polysaccharides having arabinose, galactose, rhamnose and galactouronic acid (Jani *et al.*, 2009).

Mucilages and gums have many similar properties, but the only thing in which they differ is that mucilages are metabolic products which are formed within the cell and can be produced without making injury/incision to the plant. Mucilages and their polymeric derivatives from distinct sources are extensively used in pharmaceutical dosage forms (Galati *et al.*, 2002). In this context; we have deliberated various aspects of mucilages starting from their Isolation, characterization, application and Modifications of existing mucilages.

ISOLATION OF MUCILAGE

Various methods of isolation of mucilages depending on the presence of mucilage in a particular plant part such as stem, leaves, fruit, seeds, tubers etc. The techniques used for isolation from leaves, i.e. the drying process was not performed whereas, for extraction of mucilage from other plant parts, the stem drying process is essential. In the case of the method used for isolation from the fruit of a plant, they are made to be directly crushed in a mixer without drying.

Although there are differences in the methods followed in which chemicals are utilized for isolation. The standard chemicals used for isolation are Petroleum ether, acetone, ethanol etc. (Sumanta and Rahaman, 2018)

In the flow chart (Figure 1), the general isolation method for mucilage was described. But now a day's using some advanced techniques yield of mucilage was increased. In 2011 Biren Shah, et al. used a microwave-assisted extraction technique used for isolation of okra mucilage. Microwave-assisted extraction performed at the intensity of 160W for 40 minutes duration of heating increased 11.55% yield of mucilage when compared to the conventional heating method for 1 hour (Shah and Seth, 2011). Hence, mucilage can be extracted from various plants using the method mentioned in Figure 1.

Characterization of Mucilage

Preliminary confirmatory test for Mucilage is given in Table 1. (Khandelwal, 2008)

Chemical Characterization

Various identification tests were performed to confirm the presence of amino acids, tannins, saponins, phenols, flavonoids, terpenes, glycosides, steroids, alkaloids, oils and fats

Structural Characterization

Mucilages contain sugar (Polysaccharides), so by using various chromatographic methods like TLC, HLPC & HPTLC presence of sugars can be confirmed and FTIR, Mass and NMR Spectroscopic can be used for structural elucidation.

Physicochemical Properties

Various physicochemical properties can be determined by using parameters such as hygroscopic nature, shape, texture, touch, colour, odour, taste, pH, solubility, swelling index, LOD, percentage yield, total ash, Acid insoluble ash, melting point, Moisture content, true density, bulk density, angle of repose and surface tension and presence of various microbes and pathogens can be determined by various microbial assays. Mucilages are vicious & produce thick gel-like mass in solution and to decide its commercial use and industrial application rheological properties of excipients are evaluated.

Impurity determination

To determine or detect the impurities present various analytical techniques can be used.

Toxicity

For determination of acute toxicity of mucilage Fix dose method (OECD Guideline No. 425) can be used. (Mazumder *et al.*, 2010; Malsawmtluangi *et al.*, 2014)

Pharmaceutical Applications of mucilages

Application of some plant mucilages are summarized given in Table 2.

Modification of existing mucilage

Mucilages are the biodegradable materials used in drug delivery systems, and they have some disadvantages like thickening, decrease in viscosity on prolonged storage, uncontrolled hydration rate & microbial growth, to overcome these disadvantages

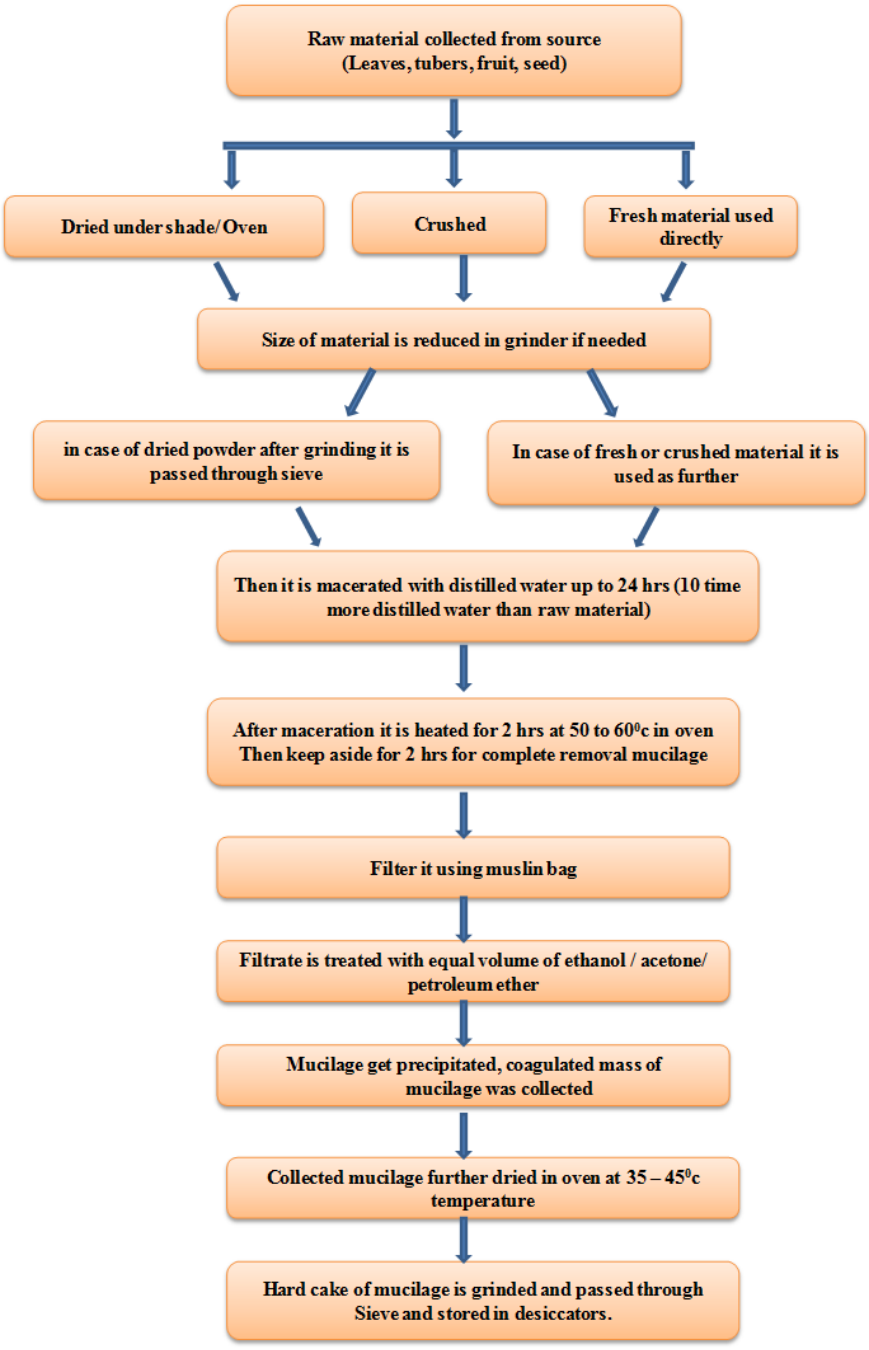

Figure 1: General Isolation Method of Mucilage

Table 1: Preliminary Confirmatory Test for Mucilage

Sr. No	Observation	Inference
Molisch's Test:		
100 mg of dried mucilage powder was taken and to that powder Molisch's reagent was added and then Conc. H_2SO_4 from the side of the test tube	Violet coloured ring observed at the junction of two layers	Carbohydrates present
Ruthenium Test:		
A Small quantity of dried mucilage powder was mounted on a slide containing ruthenium red solution and it is observed under microscope	Development of Pink colour observed	Mucilage present
Iodine Test:		
100 mg of dried powder was taken and in that 1 ml of 0.2 N Iodine solution is added	Colourless solution obtained	Polysaccharides present (Starch Absent)

and problems it requires some modification. (Singh and Sharma, 2008).

These modifications methods involve:

Carboxymethylation/carbomoyethylaion

Modification can be done by replacing some free hydroxylgroupswhich enhances the water/aqueous solubility of mucilage and clarity of the solution. (Rana *et al.*, 2011)

Cross linking or grafting

Cross linking or grafting of vinyl monomers on polysaccharides using Physical & chemical Methods producing a promising material which can be used in drug delivery systems.

1. **Physical methods:** Modification by physical means can be done by exposing mucilages/polymerstomicrowave, Ultra Violet, gamma radiations, dry heat and saturated steam. (Khan *et al.*, 2006; Desai and Park, 2006)
2. **Chemical Methods:** Modification by chemical means include treating/heating mucilage/polymer with compounds like aldehydes, epichlorhydrin, borax or glutaraldehyde. (Micard *et al.*, 2000)

CONCLUSION

There are large numbers of mucilage's available, having various applications in pharmaceutical preparations are reviewed and discussed. Natural excipients are preferable as not only they are fulfilling their role but also providing health benefits by overcoming the risks associated with synthetic excipients. More research efforts should be provided on natural excipients to innovate non-toxic, biocompatible, cost-effective, eco-friendly suitable for the development of dosage forms.

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Conflict of interest

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Table 2: Pharmaceutical applications of plant

Sr. No	Botanical Name	Family	Pharmaceical Applications
1	Abelmoschus esculentus	Malvaceae	Binding agent & as a sustained release in tablet formulations (Kumar *et al.*, 2009)
2	Aloe species	Liliaceae	Gel forming &sustained release agent (Jani *et al.*, 2007)
3	Lepidum sativum	Cruciferae	Suspending agent, emulsifier & as a controlled release in tablet formulations (Mehta *et al.*, 2010)
4	Ocimum canum	Labiatae	Suspending agent & Emulsifier (Patel *et al.*, 1987)
5	Trigonella foenum graecum	Leguminoseae	Binding & Gel forming agent, Binder & disintegrant in tablet formulations and also as an emollient & Demulcent (Kulkarni *et al.*, 2002b)
6	Hibiscus esculentus Linn	Malvaceae	Emulsifier, Suspending and Sustaining agent (Wahi *et al.*, 1985)
7	Hibiscus rosasinensis Linn	Malvaceae	Suspending agent & as a sustaining Agent (Edwin *et al.*, 2007)
8.	Plantago psyllium and Plantago ovata	Plantaginaceae	Binding, emulsifying, sustaining agent and also as a lubricant (Shidhaye *et al.*, 2007)
9.	Ocimum gratissimum Linn	Labiatae	Binder & Suspending agent (Anroop *et al.*, 2005)
10	Asparagus racemosus	Aapocynaceae	Binder and sustaining agent in Tablet formulations (Kulkarni *et al.*, 2002a)
11	Opuntiaficus-indica	Cactaceae	Gel forming agent (Cardenas *et al.*, 1997)
12	Anacardium occidentale	Anacardiaceae	Gel forming agent (Kumar *et al.*, 2009)
13	Cassia sophera	Fabaceae	Binding agent (Kulkarni *et al.*, 2002a)
14	Chlorophytum borivilianum	Asparagaceae	Suspending agent& binding agent (Deore and Khadabadi, 2008)
15	Delonixregia	Fabaceae	Binding agent (Kale *et al.*, 2009)
16	Vignamungo	Fabaceae	Binding agent (Yadav *et al.*, 2009)
17	Cissuspopulnea	Vitaceae	Binding agent (Eichie and Amalime, 2007)
18	Caesalpiniap ulcherrima	Fabaceae	Granulating & Binding agent (Selvi *et al.*, 2010b)
19	Cassia angustifolia	Fabaceae	Granulating & Binding agent (Singh and Singh, 2010b)
20	Zizyphus jujubalamk	Rhamnaceae	Binding agent (Singh *et al.*, 2010)
21	Prosopisjuliflora	Mimosaceae	Binding agent (Selvi *et al.*, 2010a)
22	Cassia auriculata	Fabaceae	Binding agent (Singh *et al.*, 2009)
23	Cassia fistula	Cassia fistula	Binding agent (Singh and Singh, 2010a)
24	Dilleniaindica	Dilleniaceae	Gel forming agent (Kuotsu and Bandyopadhyay, 2007)
25	Alyssum halocarpus	Brassicaceae	Viscosity enhancer (Koocheki *et al.*, 2009)
26	Coriolushirsutus	Polyporaceae	Base for gel preparation (Rao *et al.*, 2010)
27	Chlorophytum borivilianum	Asparagaceae	Suspending agent (Naglschmid *et al.*, 1982)
28	Hibiscus rosasinensis	Malvaceae	Super-disintegrant (Shah and Patel, 2010)
29	Mimosa pudica	Fabaceae	Bioadhesive polymer (Ahuja *et al.*, 2010)

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