ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 02, pp.26866-26871 February, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

ISOLATION AND EVALUATION OF MUCILAGE FROM HERBAL PLANT AS A PHARMACEUTICAL EXCIPIENT

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ARTICLE INFO

Article History:
Received 24th November, 2015
Received in revised form
05th December, 2015
Accepted 17th January, 2016
Published online 27th February, 2016

Key words:

Gums and Mucilage,
Cruciferae,
Lepidium sativum,
Isolation.

ABSTRACT

In recent years, plant derived polymers have evoked tremendous interest due to their diverse pharmaceutical applications such as diluents , binders, disintegrants in tablets, thickeners in oral liquids, protective colloids in suspensions, gelling agents in gels and bases in suppository. These polymers such as natural gums and mucilage are biocompatible, cheap and easily available and are preferred to semi synthetic and synthetic excipients because of their lack of toxicity, low cost, availability, soothing action and non-irritant nature. Present study was focusing on isolation of mucilage from herbal plants with their evaluation as pharmaceutical excipient. The mucilage of plant of family of *Cruciferae* was collected from seeds. Seeds of the plant *Lepidium sativum* were isolated. Characterized for various parameters such as pH, Melting Point, Physical Appearance, solubility etc. The *Lepidium sativum* mucilage has been reported to have the gel forming potential. The mucilage is isolated by dissolving in water and precipitating in acetone. The morphological and physical evaluatory study of isolated mucilage shows, it is brownish powder, with characteristic odor. It is soluble in warm water, practically insoluble in ethanol, acetone, ether and chloroform. Moisture content of mucilage was found to be 106.12 %.The swelling index was found to be 18. And ash value was found to be 0.066%. The bulk density and tapped density of mucilage was found to be 0.60 and 0.40 gm/cc. The results of chemical test shows presence of Carbohydrate while the absence of Tannins, Chloride and Sulphate. The isolated mucilage was found acceptable for all the tested organoleptic properties.

Citation: **Tufail Dana, Nilima Thombre and Archana Deokar, 2016.** "Isolation and evaluation of mucilage from herbal plant as a pharmaceutical excipient", *International Journal of Current Research,* 8, (02), 26866-26871.

INTRODUCTION

In recent years, plant derived polymers have evoked tremendous interest due to their diverse pharmaceutical applications such as diluents , binder, disintegrant in tablets, thickeners in oral liquids, protective colloids in suspensions, gelling agents in gels and bases in suppository. These polymers such as natural gums and mucilage are biocompatible, cheap and easily available and are preferred to semi synthetic and synthetic excipients because of their lack of toxicity, low cost, availability, soothing action and non-irritant nature. Demand for these substances is increasing and new sources are being developed. Mucilage's are most commonly used adjuvant in pharmaceutical preparations. Plant mucilage's are pharmaceutically important polysaccharide with wide range of applications such as thickening gelling agent, binding, disintegrating, suspending, emulsifying, stabilizing and gelling agents.

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They have been also used as matrices for sustained and controlled release drugs. Naturally available mucilage's are preferred to synthetic materials due to their non-toxicity, low cost, emollient and non-irritating nature. Acacia, tragacanth, gum ghati, gum karaya are popular examples of plant mucilage's. Present paper deals with isolation, photochemical screening and evaluation of binding properties of *Hibiscus esculentus* mucilage. As a dose formulators essential to develop cost-effective and less tedious procedures for preparation of sustained release formulations on the industrial scale.

The most commonly used method for fabricating drugs in a controlled-release formulation is by incorporating them into a matrix containing a hydrophilic rate controlling natural polymer. Mucilage in Plant Parts: Polysaccharide hydrocolloids including mucilage, gums and glucans are abundant in nature and commonly found in many higher plants. These polysaccharides constitute a structurally diverse class of biological macromolecules with a broad range of physicochemical properties which are widely used for various applications in pharmacy and medicine.

Although mucilage can occur in high concentration in different plant organs, their physiological function in most cases is unclear. Mucilage found in rhizomes, roots and seed endosperms may act primarily as energy reserves whereas foliar mucilage's appear not to serve as storage carbohydrates. Generally, it has been assumed that foliar mucilage's are merely secondary plant metabolites, but there are reports that they may play a role in frost tolerance, water transport, wound responses, plant host–pathogen interaction. The ionic balance of plant cells as carbohydrate reserves. Due to the high concentration of hydroxyl groups in the polysaccharide, mucilage generally has a high water-binding capacity and this has led to studies of their role in plant water relations. It has been suggested that the ability of mucilage to hydrate may offer a mechanism for plants to resist drought. By the term "mucilage in plants" is meant those substances which are soluble or at least swell very perceptibly in water and which, upon the addition of alcohol, are precipitated in a more or less amorphous or granular mass. Mucilage originates in the plant either as a part of the contents of the cell or as a part of the wall there of. (Malviya *et al*. 2011)

What are gums and mucilage?

Gums are considered to be pathological products formed following injury to the plant or owing to unfavorable conditions, such as drought, by a breakdown of cell walls (extra cellular formation; gummosis) while, mucilage are generally normal products of metabolism, formed within the cell (intracellular formation) and/or are produced without injury to the plant. Gums readily dissolve in water, whereas, mucilage form slimy masses. Gums are pathological products, whereas mucilageare physiological products. Acacia, tragacanth, and guar gum are examples of gums while mucilageare often found in different parts of plants. For example, in the epidermal cells of leaves (senna), in seed coats (linseed, psyllium), roots (marshmallow), barks (slippery elm) and middle lamella (aloe). Gums and mucilage have certain similarities—both are plant hydrocolloids. They are also translucent amorphous substances and polymers of a monosaccharide or mixed monosaccharides and many of them are combined with uronic acids. Gums and mucilage have similar constituents and on hydrolysis yield a mixture of sugars and uronic acids. Gums and mucilage contain hydrophilic molecules, which can combine with water to form viscous solutions or gels. The nature of the compounds involved influences the properties of different gums. Linear polysaccharides occupy more space and are more viscous than highly branched compounds of the same molecular weight. The branched compounds form gels more easily and are more stable because extensive interaction along the chains is not possible. (Jani *et al*. 2009, Ravindrakullai & Manjunath 2013)

Disadvantages of synthetic polymers

The synthetic polymers have certain disadvantages such as high cost, toxicity, environmental pollution during synthesis, non-renewable sources, side effects, and poor patient compliance. Acute and chronic adverse effects (skin and eye irritation) have been observed in workers handling the related substances methyl methacrylate and poly- (methyl methacrylate) (PMMA).

Reports of adverse reactions to povidone primarily concern the formation of subcutaneous granulomas at the injection site produced by povidone. There is also evidence that povidone may accumulate in organs following intramuscular injections. Acute oral toxicity studies in animals have indicated that carbomer-934P has a low oral toxicity at a dose of up to 8 g/kg. Carbomer dust is irritating to the eyes, Mucous membranes and respiratory tract. So, gloves, eye protection and dust respirator are recommended during handling. Studies in rats have shown that 5% polyvinyl alcohol aqueous solution injected subcutaneously can cause anemia and can infiltrate various organs and tissues. Some disadvantages of biodegradable polymers used in tissue engineering applications are their poor biocom- patibility, release of acidic degradation products, poor processing ability and rapid loss of mechanical properties during degradation. It has been shown that poly glycol-lides, polylactides and their co-polymers have an acceptable biocompatibility but exhibit systemic or local reactions due to acidic degradation products. An initial mild inflammatory response has been reported when using poly-(propylene fumarate) in rat implant studied. (Ravindrakullai & Manjunath 2013, Jani *et al*., 2009)

Advantages of mucilage

The following are a number of the advantages of natural plant–based materials

- Local availability— In developing countries, governments promote the production of plant like guar gum and tragacanth because of the wide applications in a variety of industries
- Biocompatible and non-toxic — chemically, nearly all of these plant materials are carbohydrates composed of repeating sugar (mono saccharides) units. Hence, they are non- toxic.
- Low cost — It is always cheaper to use natural sources. The production cost is also much lower compared with that for synthetic material. India and many developing countries are dependent on agriculture.
- Biodegradable — Naturally available biodegradable polymers are produced by all living organisms. They represent truly renewable source and they have no adverse impact on humans or environmental health (e.g. skin and eye irritation).
- Environmental friendly processing — Gums and mucilage's from different sources are easily collected indifferent seasons in large quantities due to the simple production processes involved. (Jani *et al*. 2009, Ravindrakullai & Manjunath 2013)

Disadvantages of mucilage

- Reduced viscosity on storage - Normally, when gums and mucilage's come into contact with water there is an increase in the viscosity of the formulations. Due to the complex nature of gums and mucilage's (mono saccharides to polysaccharides and their derivatives), it has been found that after storage there is reduced in viscosity.
- Batch to batch variation — Synthetic manufacturing is a controlled procedure with fixed quantities of ingredients,

while the production of gums and mucilage's is dependent on environmental and seasonal factors.

- Microbial contamination — the equilibrium moisture content present in the gums and mucilage's is normally 10 % or more and, structurally, they are carbohydrates and, during production, they are exposed to the external environment and so there is a chance of microbial contamination. However, this can be prevented by proper handling and the use of preservatives.
- Uncontrolled rate of hydration — Due to differences in the collection of natural materials at different times, as well as differences in region, species, and climate conditions the percentage of chemical constituents present in a given material may vary. There is a need to develop suitable monographs on available gums and mucilage's. (Ravindrakullai & Manjunath 2013)

Chemical nature of gums and mucilage

Gums and mucilage, because of their polysaccharide nature, produce an indefinite number of monosaccharides on hydrolysis. Depending on the type of hydrolysis products obtained, they can be further classified into pentosans (e.g. xylan) and hexosans (e.g. starch and cellulose). Gums are pathological products consisting of calcium, potassium and magnesium salts of complex substances known as 'polyuronides'. Mucilageare physiological products related to gums, but they are generally sulfuric acid esters, the ester group being a complex polysaccharide. Both gums and mucilage are closely related to hemicelluloses in composition, except that the sugars produced by hemicelluloses are glucose, mannose and xylose, whereas those produced by gums and mucilage are galactose and arabinose. (Kulkarni 2002)

Applications of gums and mucilage

Gums and mucilage of different sources and their derivatives represent a group of polymers widely used in pharmaceutical dosage forms. Various kinds of gums are used in the food industry and are regarded as safe for human consumption. However, there is growing concern about the safety of pharmaceutical excipients derived from natural sources. Plant gums and exudates are now screened for their use as pharmaceutical adjuvants. Mucilage of different origins is also used in conventional dosage forms of various drugs for their binding, thickening, stabilizing and humidifying properties in medicine.

Newer uses of different gums and mucilage in cosmetics and textiles have increased the demand and screening of gums has become an important pharmaceutical area. However, different gums and mucilage used as pharmaceutical adjuvants have stringent specifications, which few natural agents can fulfill. Gums and mucilage have the following applications. Gums and mucilage have a variety of applications in pharmacy. They are used in medicine for their demulcent properties for cough suppression. They are ingredients of dental and other adhesives and can be used as bulk laxatives. These hydrophilic polymers are useful as tablet binders, disintegrants, emulsifiers, suspending agents, gelling agents, stabilizing agents, thickening agents, film forming agents in transdermal and periodontal films, buccal tablets as well as sustaining agents in matrix tablets and coating agents in microcapsules including those used for protein delivery. Some of examples are mentioned in in table no 1. (Ravindrakullai & Manjunath 2013, Malviya *et al*., 2011)

Table 1. Application of Gums and Mucilage

Name	part	property
Sesbania seed	Seed	Gelling agent
Hibiscus Rosasinesis	Leaves	Gelling agent
Anacardium occdentale	Leaves	Gelling agent
psyllum husk mucilage	Husk	Gelling agent
Remusatia vivipara	Tuber	Gelling agent
Isapghula husk	Husk	Gelling agent
Fenugreek mucilage	Seed	Gelling agent
Borassus flabellifer	Fruit	Gelling agent
Trigonellia foinum grasicum	Seed	Gelling agent
Spinacia oleracea L	Leaves	Gelling agent
Viunamungo	Seed	Gelling agent

Seed

The seeds from plant of family of *Cruciferae*, contain a high proportion of mucilage and it also being used for different therapeutic purposes. The plant exudates (Acacia, karaya, and Tragacanth) have been the traditional gums for pharmaceutical purposes and they still find significant applications. These gums are labour intensive and carry premium price and their use will probably continue to decline. (Manohar *et al*., 2012)

Physicochemical properties of mucilage

The evaluation of separated mucilage was done for its physicochemical characteristics such as its morphological characteristics, identification by chemical test, solubility (water soluble or alcohol soluble.), pH, loss on drying, swelling index, identification by chemical tests, ash values, and flow properties etc. The evaluation was carried out as per procedures describe in official books.

MATERIALS AND METHODS

Isolation of mucilage

The mucilage of plant of family of *Cruciferae* was collected from seeds. Seed was procured form local market in the form of very small brown seeds. Seeds of *Lepidium sativum* contain mucilage around the outer layer. The major problem in isolation of mucilage is that it swells but does not separate easily from the seeds. Therefore effective method was developed by soaking the seeds of with 10 times its weight of distilled water and kept for 24 Hrs. The viscous solution was sucked by syringe with the continuous homogenizing with the help of homogenizer. The mucilage was precipitated out by addition acetone in the ratio of 1:1 by continuous stirring. The coagulated mass was dried in oven at 40 – 45 °C, powdered by passing through sieve and stored in airtight container (yield – 14% w/w).

Characterization of Mucilage

- The separated mucilage was evaluated for its physicochemical characteristics such as its

- Morphological characteristics, identification by chemical tests, Solubility, melting range,
- pH, Swelling index, Ash values, presence of foreign organic matter, test for lead and arsenic, Loss on drying, Density, The evaluation was carried out as per procedures describe in official books. (Jain *et al*., 2013)

Figure 1. Isolation of mucilage from seeds of *Lepidium sativum*

1. **pH**:

The pH of the 1% w/v aqueous mucilage solution was measured with a pH meter.

2. **Melting point**

Melting point was determined by using melting point apparatus of make- , model- .

3. **Description**

- Color: pale yellow to brown in color
- Odor: Characteristics

4. **Solubility**

A required quantity of mucilage was taken and added to the warm water. A required quantity of mucilage was taken and checked it's solubility in inorganic solvents like methanol and chloroform.

5. **Loss on drying**

- Weigh about 1.5 h of the powered drug into a weighed flat and thin porcelain dish.
- Dry in the oven at 100℃ or 105℃, until two consecutive weighing do not differ by more than 0.5 mg.
- Cool in desiccators and weigh. The loss in weight is usually recorded as moisture.

6. **Total Ash**

- Weigh and ignite flat, thin, porcelain dish or a tared silica crucible.
- Weigh about 2 g of the powdered drug into the crucible.
- Support the dish on a pipe-clay triangle placed on a ring of retort stand.
- heat with a burner, using a flame about 2 cm high and supporting the dish about 7 cm above the flame, heat till vapor's almost cease to be evolved; then lower the dish and heat more strongly until all the carbon is burnt off.
- Cool in desiccators.
- Weigh the ash and calculate the percentage of total ash with reference to the air dried sample of the crud drug.

7. **Test for Carbohydrates**

Molisch's test: Take 2-3 ml aqueous extract, add few drops of alpha-naphthol solution in alcohol, shake and add conc. H_2SO_4 from sides of the test tube. Violet ring is formed at the junction of two liquids.

Table 2. Physicochemical characteristics of *Lepidium sativum* seed mucilage

S.No.	Test	Observation
1.	Description	Pale-yellow, brown colour powder
2.	solubility	Sparingly soluble in warm water, Inorganic solvents like methanol and chloroform it is insoluble.
3.	odour	Characteristics
4.	Identification-mounted on ruthenium red	Particle stains red or pink
5.	pH (1% w/v)	Neutral
6.	Loss on drying	106.12%
7.	Ash value	0.066%
8.	Swelling index	18
9.	Test for carbohydrates (Mollisch test)	+
10.	Test for tannins (ferric chloride test)	_
11.	Test for chlorides (silver nitrates test)	_

(+ present , - absent)

Table 3. Physicochemical characteristics of *Lepidium sativum* seed mucilage

S.No	Parameter	Result
1.	Solubility	Sparingly soluble in warm water. Insoluble in methanol and chloroform.
2.	Swelling index	18
3.	Loss on drying	106.12%
4.	Bulk density	0.60
5.	Tapped density	0.40

8. Test for Proteins

Biuret test: take 3 ml test solution add 4% NaOH and few drops of 1% $CuSO_4$ solution. Violet or pink colour appears.

9. Test for tannins

Ferric chloride solution test: take 2-3 ml of aqueous or alcoholic extract, add few drops of ferric chloride solution. Deep blue- black colour.

10. Test for sulphate

Barium chloride test: to 5 ml filtrate, add few drops 5% $BaCl_2$ solution white crystalline $BaSO_4$ ppt. appears, Insoluble in HCL

11. Test for Mucilage

Ruthenium red: required quantity of mucilage mount in ruthenium red .stains reddish pink.

12. Density

Bulk density (BD) and tapped density (TD) of drug and powder admixture were determined. 10gm of drug and powder admixture was introduced into a 100 ml calibrated measuring cylinder in density apparatus. After noting down the initial volume, cylinder was allowed to fall under its own weight on to a hand surface from the height. The tapping was continued for 100 tapping complete and further change in volume after 100 tapping was noted. BD and TD were calculated using following equation,

Bulk density (BD) = weight of powder / bulk volume (gm/ml) ----- (1)
Tapped density (TD) = weight of power / tapped volume (gm/ml) - (2)

13. Swelling index

The swelling index factor gives an idea about the mucilage content of the drug, hence it is useful in the evaluation of crude drug containing mucilage.

- Take 1 gm of the seeds in a 25 ml stoppered cylinder.
- Add water up to 25 ml marking.
- Shake occasionally during 23 hours.
- Keep aside for one hour.
- Measure the volume occupied by the swollen seeds.

RESULTS AND DISCUSSION

The *Lepidium sativum* mucilage has been reported to have the gel forming potential. The mucilage is isolated by dissolving in water and precipitating in acetone. The morphological and physical evaluatory study of isolated mucilage shows, it is brownish powder, with characteristic odour. It is soluble in warm water, practically insoluble in ethanol, acetone, ether and chloroform. Moisture content of mucilage was found to be 106.12 %.The swelling index was found to be 18. And ash value was found to be 0.066%. The bulk density and tapped density of mucilage was found to be 0.60 and 0.40 gm/cc. The result of chemical test shows presence of carbohydrate. While the absence of Tannins, chloride and sulphate.

Conclusion

It was concluded that the developed method of isolation of mucilage increased the yield of mucilage. The mucilage isolated from seeds showed the presence of carbohydrates and was found acceptable for all the tested organoleptic properties. From solubility analysis it was found to be sparingly soluble in warm water, Inorganic solvents like methanol and chloroform it is insoluble.

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