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A potential natural tablet binder from *Grewia Optiva*

Vijay J Kumar*, O. P. Sati* and Ranjit Singh#

**School of Sciences, HNB Garhwal University, Srinagar (Garhwal), Uttarakhand, India*
 # School of Pharmaceutical Sciences, Shobhit University, Meerut, Uttar Pradesh, India

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ABSTRACT

The purpose of the present study was to investigate the efficacy of mucilage obtained from G. optiva as tablet excipient, in particular as binder. Gum mucilage was isolated from the bark of G. optiva. The rheological behavior of the obtained gum mucilage was compared with other gums. The mucilage was further subjected to physicochemical characterization. Also, a comparative study on binding properties of gum mucilage and starch was performed. The gum mucilage obtained from the G. optiva exhibited superior rheological properties. The studies performed with preservatives revealed that inclusion of preservatives, effectively control the tendency of gum to loose viscosity on keeping for long. The physicochemical characterization showed good flow properties and excellent swelling ratio. Grewia optiva gum mucilage could be considered as a cheap, economic and easily available tablet binder. Moreover being of natural origin, it will be more acceptable.

Keywords: *Grewia optiva*, herbal excipients, tablet binders, viscosity.

INTRODUCTION

Excipients are the additives used to convert active pharmaceutical ingredients into pharmaceutical dosage form suitable for administration to patients [1]. Herbs are non- polluting renewable resources for sustainable supply of cheaper pharmaceutical excipients or products. New and improved excipients continue to be developed to meet the needs of conventional drug delivery systems in general and that of tablet manufacturing in particular [2]. Plant products serve as an alternative to imported or other synthetic products because of local availability, environment friendly nature and lower prices.

As a natural defense mechanism to prevent infection or dehydration many trees and shrubs are known to produce an aqueous thick exudation when the plant bark is injured [3]. Eventually the

solution dries up while in contact with sunlight and air. This solid exudate, a hard transparent brown- tint glass like mass is known as natural gum. Sometime these exudates do not come outside in form of hard masses and then efforts could be made to isolate them in form of mucilages [4]. A number of plant based pharmaceutical excipients are explored by the researchers for their pharmaceutical utility [5-12].

Grewia optiva is an important agro forestry tree. It is popularly known as Bhimal, Bhiunal and Bhiuli. It is a tree of 12m height, found in deciduous forests of India, Srilanka, Pakistan, Thiland, China and Phillipines. Leaves are ovate and lanceolate, acuminate, base rounded with prominent nerves, margin serrate, stallately hairy on both surfaces. Flowers can be collected in April- June and fruiting season is in the months from August to November. The bark fiber is extensively used for ropes, nets, brooms and stick after peeling off the bark are used to lit fire. Leaves are a useful fodder [13].

In the present study, an effort was made to access the efficacy of gum mucilage of *G. optiva* as a tablet binder. The binding capability of the gum mucilage was also compared with other conventional mucilages used as tablet binder.

MATERIALS AND METHODS

Starch was procured from E. Merk (India) Ltd., Mumbai, India. *G. optiva* bark was collected from Garhwal region of Himalaya's, India. The gum mucilage was isolated using a method developed in the laboratory. All other chemicals used were of analytical- reagent grade, if not otherwise mentioned.

Collection of the Plant

The bark was collected in the month of February from the Himalyan region of Garhwal, Uttarakhand (India).The tree was identified by Prof. R.D. Gaur, Department of Botany, HNB, Garhwal University and was also entered in the Herbarium of the University (GUH-1504).

Isolation of gum mucilage

The bark was peeled off from branches and stem and sliced into small pieces with help of sharp knife.

Small pieces of bark were soaked in cold water, kept overnight and crushed. The mucilage was separated by straining through fine muslin cloth. The collected mucilage was equally divided into two parts. One part was dried under sunlight till dried residue was obtained. The other part was dried in an oven at 50^0C. The mucilage powder obtained was passed through 120 mesh.

The powdered mucilage obtained after drying was defatted by soxhlet extraction using 250 ml of petroleum ether at $50^0 – 70^0$C and repeatedly extracted with hot water till the complete mucilage was extracted. The mucilaginous mixture was then filtered through fine muslin cloth and again precipitated with acetone. The obtained precipitates were dried in an oven at 40^0C. The mucilage powder was passed through 120 meshes.

Determination of viscosity of the mucilage

The viscosity of the mucilage was determined with a Brookfield Viscometer at room temperature. Also, the stability of the various concentration of mucilage with and without use of preservatives was performed with respect to time

Physico-chemical characterization of the mucilage

The mucilage powder was evaluated for solubility, swelling index, loss on drying, density, compressibility index and angle of repose [14].

Solubility

The solubility is expressed in terms of 'parts' representing the no. of mililiters (mL) of the solvent in which 1gm of the solid is soluble. Solubility of powder was determined in different solvents at room temperature as per IP-1996 [15].

Swelling Index

The swelling characteristics of the separated mucilage powder were studied in different media such as 0.1N HCl, Phosphate buffer (pH- 7.4) and distilled water.

Mucilage powder (1gm) was moistened with 0.5ml of ethanol (95%) and volume was made upto 10 ml with respective medium (PBS, DW, 0.1N HCl) in a measuring cylinder. The cylinder was shaken vigorously every 10 minutes for 1 hour and allowed to stand for 3 hours. Then the volume occupied by the powder was measured. The test was carried out in triplicate and the average value of Swelling Index was recorded.

Loss on drying

The inherent moisture in additives may influence the stability of dosage form containing moisture sensitive drugs, so the moisture content of the separated mucilage was detected by loss on drying method. The sample (1gm) was heated at 105^0C until constant weight in a hot air oven and percentage loss of moisture on drying was calculated using the formula

LOD (%) = (Weight of water in sample)/ (Wt. of dry sample) x 100

Table: 1: Results of physico-chemical characterization of powder

Parameters	**Result**
Solubility	Soluble in water in low concentration (slightly soluble), practically insoluble in acetone, ethanol, ether and chloroform
Swelling ratio Mean (n = 3)	In 0.1N HCl = 6.5 In PBS, pH 7.4 = 5.0 In distilled water = 40
Loss on drying	1.0%

Formulation and Evaluation of the binding properties of *G. optiva* mucilage

Preparation of the Granules and tablets

Four different batches of paracetamol tablet were formulated by using Paracetamol & other excipients. Lactose and starch powder were passed through sieve no.40. Paracetamol IP was mixed with lactose and starch powder and was homogenously dry-mixed. Wet granulation

method was used for preparation of granules using *G. optiva* mucilage and starch binders in concentration of 2.5%, 5%, 7.5% and 10% {batch 1, 2, 3, and 4, (GO1 to GO4) for *G. optiva* and (S1 to S4) for starch}. The damp mass was passed through sieve no. 16 and was dried at 50^0C in an oven for 1hour. The dried granular mass was passed through sieve no. 20 to obtain uniform sized granules. Magnesium stearate and talc were mixed with the prepared granules. The uniformly mixed blend was compressed into 450 mg tablets using single stroke compression machine.

Evaluation of granules

The granules prepared were evaluated for flow properties, bulk density, tapped density Carr's index and Hausner's ratio.

Bulk density was measured by taking accurately weighed powder into a gradated cylinder of tapped density apparatus and the volume was measured and recorded as bulk volume. The cylinder was tapped until powder bed volume reached a constant value and the volume was recorded as tapped volume. The bulk density, tapped density, and compressibility index were calculated using the equation [16].

- Bulk density = Mass / bulk volume
- Tapped density = Mass / tapped volume
- Compressibility index = [tapped density – bulk density] / tapped density

Carr's index (CI) and Hausner's ratio

Carr's index (CI) and Hausner's ratio were calculated by the following formula [17]:
Carr's index = {(Tapped density – Bulk density) / Tapped density}X 100
Hausner's ratio = Tapped density / Bulk density

Angle of Repose (φ)

The angle of repose is used to characterize a flow property of the powder material. It was determined by conventional fixed height funnel method.

Table: 2: Characterization of Granules prepared using different binders

Parameters	GO1	GO2	GO3	GO4	S1	S2	S3	S4
Angle of Repose Mean±SD (n = 3)	32.56±2.25	29.54±1.45	27±2.10	26.54±1.45	29±1.45	27.54±2.25	28±1.50	26±1.25
Bulk Density Mean±SD (n = 3)	0.61±0.05	0.53±0.04	0.51±0.05	0.49±0.03	0.49±0.05	0.47±0.03	0.46±0.04	0.44±0.04
Tapped Density Mean±SD (n = 3)	0.70±0.05	0.60±0.03	0.57±0.04	0.53±0.05	0.53±0.03	0.52±0.04	0.51±0.03	0.50±0.05
Carr's Index(%) Mean±SD (n = 3)	12.85±0.80	11.66±0.90	10.52±0.70	7.54±0.80	7.54±0.90	9.61±0.70	9.80±0.80	12±0.70
Hausner's Ratio Mean±SD (n = 3)	1.14±0.02	1.13±0.03	1.11±0.04	1.08±0.02	1.08±0.03	1.10±0.04	1.10±0.02	1.13±0.02
% fines	6.1	5.7	4.5	3.6	5.5	5.2	4.8	4.5

% Fines

For determination of % fines, the dried granules were placed on sieve no 60. The sieve was shaken gently and from the weight of the material that passed through the sieve, % fine was calculated.

Evaluation of tablets

Compressed tablets were then evaluated for various QC parameters such as Appearance, Weight Variation, tablet hardness, friability, Disintegration time and Dissolution rate study.

Appearance

Organoleptic properties such as color and odour were evaluated. 5 tablets from each batch were selected and the colour was visually compared and odour checked.

Hardness and Friability test

Hardness was measured by Monsanto hardness tester. Friability was evaluated as the percentage weight loss of preweighed 20 tablets tumbled in a Roche friabilator, for 4 minutes at 25 rpm. The tablets were then dusted and reweighed.

Weight Variation

Twenty tablets were randomly selected from each batch and individually weighed. The average weight and standard deviation (SD) of 20 tablets was calculated according to standard method.

Disintegration time

The method specified in the IP-1996 was used. Disintegration medium used was 100ml of 0.1N HCl maintained at temperature 37±2^{o}C throughout the experiment. Six tablets selected at random from each batch were placed in each of the cylindrical tubes of the basket but no disc was used. The time taken for each tablet to break up into small pieces and pass out through the mesh was recorded. Mean disintegration time for each batch was recorded. Mean disintegration time was calculated for each batch.

***In-Vitro* dissolution study**

In-vitro dissolution studies of prepared tablets were performed using USP apparatus type-II at 50rpm in pH 7.8 phosphate buffer (900 ml) medium at the temperature 37±0.5^{o}C. At specified intervals, 5ml of samples were withdrawn and filtered through Whatmann filter paper no-41. From this filtrate 1ml was taken into 10ml volumetric flask and volume was made up to the mark. After removal of each sample, the 5ml of fresh dissolution medium was added to the vessel to maintain the constant volume. The samples were then analyzed at 249 nm by UV-Visible spectrophotometer (shimandzu-1700). The amount of drug released was determined by reference to a calibration curve constructed in same dissolution media.

Brittle Fracture Index (BFI)

The brittleness test is based on the Griffith fracture theory which teaches that, for crack growth to occur, the energy stored at the tip of a crack must just exceed the energy required to form two new surfaces resulting from the propagation of the crack. Also, the amount of energy stored at the tip of a crack is a function of the dimension of the crack.

Table: 3: Evaluation of Paracetamol tablets prepared using different binder solution

Binding agent	Formulation code	Average Weight(mg) Mean±SD (n = 3)	Hardness (kg/cm^2) Mean±SD (n = 6)	Disinegration time (min)	Friability (%) Mean±SD (n = 3)
Grewia optiva	**GO1**	448±0.20	5.13±0.20	11.30	1.34±0.04
	GO2	447±0.15	5.38±0.40	13.26	1.09±0.06
	GO3	442±0.20	5.46±0.50	17.10	0.97±0.05
	GO4	439±0.25	5.65±0.20	21.22	0.92±0.02
Starch paste	**S1**	438±0.25	5.19±0.25	10.25	0.94±0.02
	S2	442±0.20	5.24±0.30	10.28	0.86±0.03
	S3	445±0.20	5.33±0.40	15.34	0.82±0.05
	S4	449±0.25	5.47±0.20	19.33	0.73±0.04

BFI is obtained by comparing the tensile strength of tablets with a hole at their centre, which act as a built- in- stress concentration defect, with the tensile strength of tablet without a hole, both at the same relative density. The brittle fracture index of the tablet was calculated by using the following equation

$$\mathbf{BFI= [(T/T_O)-1]}$$

T= Tensile strength of tablet without a hole
T_O= Tensile strength of tablet with hole

The tensile strength, T, of the normal tablet and T_o were determined at room temperature by dimeteral compression using a Monsanto hardness tester and by applying the equation

$$\mathbf{T= 2F/\pi DT}$$

Where T(orT_o) = tensile strength (MNm^{-2})
F= force required to break tablet
D= diameter of tablet
T= thickness of a tablet

Granular density of each formulation was determined by using fluid displacement method and applying the equation

$$\mathbf{\rho_g = W/[(a+w) - b]S_g}$$

Where ρ_g = granular density in gms per cubic centimeter
W = granules weight in gram
S_g = specific gravity of liquid paraffin (0.802)
a= pycnometer + Liq. Paraffin wt. in gms
b = pycnometer + Liq. Paraffin wt. in gms+ granule wt. in gms

Table: 4: Comparative values of Brittle Fracture Index

	Conc. of binder (%)	*Grewia optiva*	Starch Paste
Brittle Fracture Index (BFI)	2.5	0.521	0.517
	5.0	0.318	0.337
	7.5	0.2886	0.221
	10.0	0.1592	0.221

RESULTS AND DISCUSSION

In this study, an effort was made to prepare paracetamol tablets using different concentrations of different binders, i.e. *Grewia optiva* and Starch.

Two different laboratory developed methods A and B were tried for isolation of gum mucilage. The yield was 11% and 23% w/w for method A and method B, respectively. The mucilage obtained by each method was a light brown powder. The mucilage powder that was obtained by method B was evaluated further because of higher yield. The mucilage showed superiority in its viscosity as compared to starch mucilage (1287.5cp).

The stability of the various concentration of mucilage with and without use of preservatives was performed with respect to time and it was found that *G. optiva* mucilage showed edge over Starch for preserved and unpreserved solution. The decrease in viscosity was much higher for *G. optiva* mucilage and Starch which have not been preserved. These studies also revealed that addition of preservatives, effectively control the tendency of gum to loose viscosity on keeping for long.

The solubility studies showed that the powder was slightly soluble in water and practically insoluble in organic solvents. Swelling characteristics studies revealed that the swelling was affected by pH of the medium (Table-1) and powder showed good swelling ratio in distilled water. The loss on drying was well within official limits. The compressibility index and angle of repose indicated that the powder is having good flow with moderate compressibility.

The physical tests (% fines, hardness test, friability and weight variation) were performed. From Table 2, it can easily be concluded that the % fines decreases with increase in binder concentration. Low percentages of fines indicate effectiveness of binder. Increase in the binder concentration has also increased the hardness of tablet. The tablets generally had good hardness values of between 5 and 6 kg/in^2. There was a decrease in friability as the binder concentration increases. All the results obtained were compared with starch binders and it was found that almost all the results shows similar pattern as shown by the mucilage obtained from *G. optiva*. These studies show that the gum mucilage possesses good tablet forming properties.

It was also observed that as the concentration of binder solution increased, there was increase in disintegration time. Despite the widely varying physico-chemical characteristics of the excipients, the drug release profiles were found to be similar. It was observed that all the batches passed disintegration time according to pharmacopoeial limits. The invitro dissolution profile is shown in Figure 1.

An increase in the binder concentration resulted in a corresponding increase in the tensile strength. The results obtained were quite promising. This increase may be attributed to the interconnective structural differences in the polymer. Such interconnectivity properties may influence the intrinsic properties.

An increase in binder concentration resulted in a corresponding increase in tensile strength. Also, the results of the binder concentration on brittle fracture index of the tablet shows that with

increase in binder concentration BFI values decreases. The lower BFI values at higher binder concentrations are an indication of the mucilages to ameliorate capping or lamination tendency of the tablets

CONCLUSION

From the studies performed it can be concluded that the gum mucilage isolated from G. optiva had comparable binding ability and appears suitable for use as a pharmaceutical binder.

REFERENCES

[1] A. Kibbe; Handbook of Pharmaceutical excipients, The Pharmaceutical Press, London, **2000**, 3, 13.
[2] R. Whistler; Industrial Gums: Polysaccharide and their derivatives, Academic Press, San Diego, 318-337.
[3] G. Weirik, J. Bergsma, S. Arends, J. Boersma, *Int. J. Pharm*., **1996**, 134, 27.
[4] D. Panda, N. Chaudhary, M. Yedukondalu, *Asian J. Pharmaceutics*, **2006**, 68(6),777.
[5] P. Bharadia, M. Patel, G. Patel, *Int. J. Pharma. Excip*., **2004,** 3, 99.
[6] K. Srinivas, K. Prakash, H. Kiran, *Indian J. Pharm. Sci*., **2003**, 65,180.
[7] V. Gilbert, *J. Med. Food*., **2002**, 5, 23.
[8] M. Khanna, R. Nandi, *Indian J. Pharm. Sci.*, **1988,** 50, 238.
[9] K. Gowthamarajan, G. Kulkarni, *Int. J. Pharm. Excip*., **2002**, 3,16.
[10] R. Nasipuri, *Nig. J. Pharm*., **1979**, 10, 182.
[11] O. Odeku, O. Itiola, *Pharm. Pharmacol. Commun*., **1998,** 4,183.
[12] O. Odeku, O. Itiola, *Drug Dev. Ind. Pharm*., **2003**, 29, 311.
[13] R. Gaur; Flora of The District Garhwal North West Himalaya, TransMedia, Srinagar (Garhwal), **1999**, 1, 150.
[14] A. Martin, P. Bustamante; Physical Chemical Principles in the Pharmaceutical Sciences, B.I. Waverly Pvt. Ltd, **1996**, 4, 423.
[15] Indian Pharmacopoeia; Ministry of Health and Family welfare, Government of India, Controller of Publication, New Delhi, **1996**, 556, A100-A111.
[16] L. Lachman, H. Liberman, J. Kanig; The Theory and Practice of Industrial Pharmacy, Varghese Publishing House, Mumbai, **1996**, 4, 293-345.
[17] M. Aulton; The Sciences of Dosage Form Design, United Kingdom, Churchill- Livingstone, **2002**