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Effect of Heating Conditions on the Physical Properties of Tamarind Seed Polysaccharide

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Abstract: The aim of this research work is to determine the effect of heating condition on the physical properties of tamarind seed polysaccharide. Tamarind seed polysaccharide was purchased as crude material, extracted and further characterized in terms of organoleptic properties and furthermore micromeritic studies of all the four different batches were carried out to characterize polymer as excipients. Viscosity of the all the four batches was range in from 65.59±1.17-73.56±2.30 poise. Angle of repose of all the four batcheswas in range from 2.31±0.11-3.06±0.41which confirmsthat the polymers are free flowing in nature.

Key words: Natural Polymer · Pharmaceutical Excipient · Extraction · Characterization · Viscosity

INTRODUCTION

Naturalplant is playing an important role as pharmaceutical excipients. They are easily available and having economic. Polymers are large macromolecules contained repeating structural units [1]. Now a day's both natural and synthetic polymers has been used in different pharmaceutical formulation. These polymers are attached with each other by covalent bonds [2]. Polymers are used as stabilizers, mechanical support and solubilizers for sustained release of drugs [3]. Polymers are widely used in pharmaceutical dosage forms and food products [4]. Biodegradable polymers have been widely used in biomedical applications because of their known biocompatibility and biodegradability [5].

Mucilageis mainly water soluble polysaccharide. Plant mucilage are most widely used as thickening agent, binding agent, suspending agent,emulsifying agent, stabilizing agent, gelling agent. They have been also used as sustained and controlled release drugs [6, 7].

Natural gums and polymers are comes in contact with water to form a gel like layer on the surface of the system for control the release of drugs. 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 (extracellular formation; gummosis) [7, 8].

Mucilage's are generally normal products of metabolism, formed within the cell (intracellularformation) and/or are produced without injury to the plant. Gums readily dissolve in water whereas mucilage forms slimy masses [9, 10].

Tamarind seed polysaccharide is a natural polysaccharide. Tamarind seed polysaccharide contains monomers of galactose, xylose and glucose sugars present in a molar ratio of 3:1:2, which constitutes about 65% of the seed components. Xylose is very crucial sugar of tamarind seed, which can be used for xylitol production, a pentahydric alcohol formed by a five carbon chain. Bioavailability of some drug has been significantly improved by the use of Tamarind seed polysaccharide as pharmaceutical excipients [11- 13].

MATERIALS AND METHODS

Plant Material: Crude plant material (*Tamarindusindica)* was purchased from local shop of Greater Noida, India. Collected plant material was identified by Department of Biotechnology, Gautam Buddha University (State Govt. University) Greater Noida.

Extraction of Mucilage: Mucilage was extracted from plant material using following two steps:

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Step 1: Extraction of Mucilage: As described by the authors elsewhere, tamarind seed were used for isolation of mucilage. Tamarind seedswere dried in hot air oven and the outer covering ofdriedseeds was removed. Seeds were boiled in water at temperature 60°C for 6 hrs. Seeds were cut into pieces and boiled for 2 hrs and kept aside for 2 hrs for release of mucilage into water. The material was squeezed in a muslin cloth to remove the mark from the filtrate and kept in refrigerator for 2-3 hrs [1-3].

Step 2: Isolation of Mucilage: Authorhas been described in a previous publication; equal volume of acetone was added to filtrate to precipitate the mucilage. Precipitated mucilage was filtered, dried in oven at about 40°C. After complete drying, powder was passed through sieve # 20. The powdered mucilage was stored in air tight container until further used [1-3].

Modification of Isolated Mucilage: Isolated mucilage was modified by using microwave radiation. Four different batches were prepared. Batch A was prepared by heating the mucilage with 0.5 power for 1 min. similarly batch B and C were prepared by heating with 0.10 and 0.15 power respectively for 1 min. batch D was prepared by heating in simple oven for 8 hours.

Physicochemical Characterization of Isolated Mucilage: Identification tests for carbohydrates, proteins, mucilage and gum: authors have been describes in elsewhere, aqueous solution of extracted was used for chemical characterization. Test for carbohydrate, proteins, mucilage, alkaloids, fats, tannins, amino acids were performing according to standard procedure [8].

Organoleptic Properties: Authors have been described the isolated mucilage was characterized for Organoleptic properties such as color, odor, taste, texture and fracture [8, 9].

pH of Mucilage: Firstly, tamarind seed polysaccharide was weighed and then dissolved in water separately to get a 1% w/v solution. The pH of solution was determined by using digital pH meter as described by author [8, 9].

Viscosity of Mucilage: It has been described by author firstly we have prepared 1% w/v solution. Viscosity was measured by using Ostwald viscometer [8,9].

Swelling Index: It has been described by authors elsewhere swelling index of the tamarind seed polysaccharide was calculated by weighed a butter paper of size 2.2 cm. then butter paper was dipped in a petridish contain 15 ml of water. 0.1 gm of the powdered sample was kept in a butter paper placedin a petridish and the swelling index was taken out at different interval i.e. 15,30, 45, 60, 120, 240, 360 and 1440 min. and final results was calculated by using swelling index formula equation 1 [8- 10].

$$\text{Swelling index} = \frac{\text{Initial weight- final weight}}{\text{Initial Weight}} \times 100 \quad (1)$$

Bulk Density and Bulkiness: It also has been described by authors that inverse of bulk density is known as bulkiness. As per previous study accurately weighed quantity of sample was placed in measuring cylinder. The cylinder was fixed on the bulk density apparatus and the volume occupied by the powder was noted. Then the powder was tapping in a bulk apparatus until constant volume was obtained. The final volume was calculated by using bulk density formula equation 2 [8- 10].

$$\text{Bulk density} = \frac{\text{Weight of powder}}{\text{Weight of apparent volume}} \quad (2)$$

Powder Compressibility (Carr's Consolidation Index): Is also known as compressibility. It has been described by authors in previous publication finely powdered tamarind seed polysaccharide (2 g) was taken and transferred into measuring cylinder and calculation were done using bulk density apparatus. Final result was calculated by using Carr's index formula equation 3 [8-10].

$$\text{Carr's index} = \frac{\text{Tapped density-bulk density}}{\text{Tapped density}} \times 100 \quad (3)$$

Powder Flow Property: Flow characteristics were measured by angle of repose as previous publication of authors. Same study was repeated here. Using the formula and calculated the angle of repose [8- 10].

Particle Size Analysis: As described elsewhere, the particle size was determined using optical microscope [8- 10].

RESULT AND DISCUSSION

Isolating mucilage from *Tamarindusindica* by *acetone* the percentage yield of gum was found to be 6.5%. Phytochemical investigation showed the presence of carbohydrates while reducing sugar, glucose, tannins, proteins and polysaccharides were absent. Results after phytochemical test of all the four different batches are summarized in Table 1.

Table 1: Chemical characterization of isolated mucilage

S.No.	Test	Batch A	Batch B	Batch C	Batch D
01.	Carbohydrates	+	+	+	+
02.	glucose	-	-	-	-
03.	Reducing Sugar	-	-	-	-
04.	Tannins	-	-	-	-
05.	Proteins	-	-	-	-
06.	Volatile oils	-	-	-	-
07.	Fats	-	-	-	-

+Present; – Absent

Table 2: Evaluation parameters of gum

Parameters	Batch A	Batch B	Batch C	Batch D
pH	6.2±0.06	6.1±0.05	6.3±0.11	6.4±0.05
Total Ash (%)	14.66±0.57	12.33±1.15	9.33±1.52	8.12±1.58
Bulk density (g/cm^3	0.67±0.01	0.66±0.01	0.67±0.01	0.690.01
Tapped density (g/cm^3)	0.76±0.06	0.81±0.05	0.83±0.03	0.78±0.09
Bulkiness (cm^3/g)	1.43±0.02	1.51±0.07	1.48±0.02	1.43±0.02
Hausner's ratio	1.09±0.09	1.23±0.01	1.23±0.05	1.13±0.01
Carr's index (%)	8.09±7.95	18.40±8.95	19.13±3.67	41.19±8.59
Angle of repose (°)	3.06±0.41	3.13±0.36	2.31±0.11	2.24±0.14
Particle size (µm)	87.28±29.87	88.57±30.78	78.46±41.59	61.64±22.14
Surface tension (dyne/cm)	69.91±1.07	66.45±2.51	74.16±0.06	74.70±0.47
Viscosity (poise)	65.59±1.17	63.64±0.12	73.56±2.30	65.12±1.47

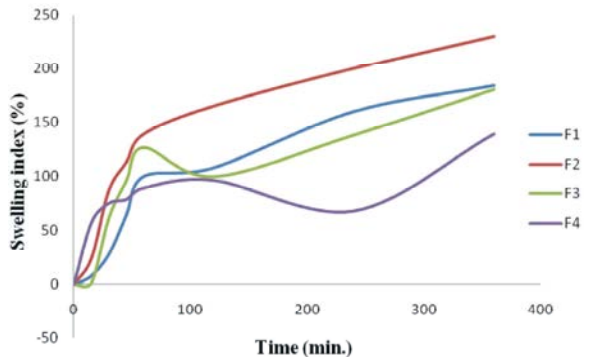

Fig. 1: Swelling index of different batches

Organoleptic Properties: Organoleptic properties of all the four different batches were observed and found to be acceptable. The color of powdered gum was light brownish. The odor and taste of all the different batches were found to be characteristic and agreeable. The fracture of all the batches was rough. All the different four batches that is batch A, Batch B, Batch C and Batch D were soluble in hot water, swell to form a gel in cold water and insoluble in methanol, ethanol, benzene and acetone.

Swelling Index: Swelling index of different batches was shown in Figure 1.

pH of 1% solution of tamarind seeds polysaccharide was found to be 6.25 which indicated it should be non-irritant in nature. Solubility study showed that it was sparingly soluble in cold water, quickly soluble in hot water and form viscous colloidal solution. The swelling property describes the high swelling ability of the tamarind seed polysaccharide. Isolated mucilage occurs high swelling properties will show drug release up to desired time period.

The modified isolated mucilage was subjected to identification. This showed presence of carbohydrates in powder. Physical characterization of tamarind seed polysaccharide was carried out for angle of repose, Carr's index, bulk density and bulkiness for flow property of isolated powdered where as these properties depends on the particle size, shapeand tendency to adhere together. Angle of repose indicates that powder is free flowing.

The bulkiness value indicated that powder is heavy in nature. Tamarind seed polysaccharide exhibited good flow characteristics. Tamarind seed polysaccharide has good flow, high swelling index. So that Tamarind seed polysaccharide can be used as a pharmaceutical excipient.

CONCLUSION

It can be concluded that the mucilage isolated from *Tamarindus indica* shows the presence of carbohydrates and found acceptable for all the tested organoleptic properties. It can be concluded from the study that thermally treated tamarind seed derived polysaccharide can be used as a pharmaceutical excipient.

Conflict of Interest: Authors have no conflict of interest.

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