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Extraction and Evaluation of Tamarind Seed Polysaccharide as Pharmaceutical *In situ* Gel Forming System

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Abstract: *Aim of study*: Present study includes extraction and characterization the tamarind *(Tamarindus indica)* seed polysaccharide as pharmaceutical excipients. *Material and methods*: By using water based extraction in Soxhlet apparatus tamarind seed polysaccharide was obtained. For characterization of the extracted tamarind seed polysaccharide phytochemical screening was done and micromeritic properties, flow behavior, and swelling index were calculated. *In situ* gel forming capacity of polymer was also evaluated with and without sodium alginate. Results revealed that extracted tamarind seed polysaccharide was soluble in warm water while insoluble in cold water and in organic solvents. It was also exhibited that extracted tamarind seed polysaccharide had good flow properties. pH was found 6.1, this showed that can be used in dosage form, without any irritation. Results also showed that this polymer can be used to form *in situ* gel with sodium alginate. *In Conclusions*: tamarind derived seed polysaccharide can be used as pharmaceutical excipient to prepare solid as well as semisolid dosage form.

Key words: Tamarind Seed Polysaccharide · Extraction · Characterization · Pharmaceutical Excipient · Natural Polymer

INTRODUCTION

In recent years, plant derived polymers have mucilages can occur in high concentrations in different evoked tremendous interest due to their diversepharmaceutical applications as a diluents, binder, disintegrant in solid dosage forms , thickeners in oral liquids formulations , protective colloids in suspensions, gelling agents in gels and bases in suppository [1]. Natural gums and polymers comes in contact with water to form gel layer on the surface of the system from that controlled the release of the drug [2].

Various natural gums come under the category of polysaccharide such as tragacanth, karaya, acacia and khaya. Natural gums have been wildly used as tablet binders, emulgents and thickeners in cosmetics and suspensions as film-forming agents and transitional colloids. Generally most of the gums absorb water, causes the gum to swell and exude by the incision. Almost gums composed of salts such as calcium, magnesium and potassium salts of bassoric acid, known as bassorin. Some of the gums have been reportedly used in an insoluble powder for suspending as a suspending agent, an emulsifying agent in emulsions for oils, resin and a binding agent [3].

Tamarind seed polysaccharide (TSP) is a natural polymer which is derived from the tamarind seed. The main component of tamarind seed has been identified as a non-ionic, neutral, branched polysaccharide consisting of a cellulose-like backbone that carries xylose and galactoxylose substituents. The configuration of TSP gives the product a 'mucin-like' molecular structure, thus conferring optimal mucoadhesive properties. Research has also shown that, at the concentrations present in the ophthalmic formulations studied, one important characteristic of TSP that makes it similar to natural tears, i.e. its ability to crystallise in a fern-like shape +. It has been suggested that due the

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structure similarity of the TSP to endogenous mucin may allow a formulation containing this polymer to adhere readily to the ocular surface for prolonged periods and provide sustained relief from the symptoms of dry eye [4].

MATERIALS AND METHODS

Extraction Procedure: Tamarind seed was obtained as a waste material from local grocery shop. Dried seed was cut into pieces and powdered in to electric grinder. Powdered seed was further passed from sieve # 20 and stored in air tight container until used.

Extraction of tamarind polysaccharide includes two steps.

Step1: Extraction of Tamarind Seed Polysaccharide: As the authors described elsewhere, tamarind seed polysaccharide was extracted under reflux in a condensation system using water as solvent. Temperature of extraction media was maintained at 70°C and duration of extraction was adjusted about 6 hrs. The extractor thimble was a Whatman cellulose thimble with 33 mm internal diameter and 80 mm external length [5,6].

Step2: Isolation of Tamarind Seed Polysaccharide: As shown by authors in a previous publication, hot water extract was pressed in cheese cloth bag and the concentrated juice was cooled to 4°C. Tamarind seed polysaccharide was precipitated by alcohol-juice treatment 2:1 (v/v) followed by continuous stirring for 15 min and mixture was further allowed to stand for 2 hrs for better Tamarind seed polysaccharide precipitation. This allows filtering polysaccharide substances because tamarind seed polysaccharide remains float on the surface of alcohol-water mixture. Floating tamarind polysaccharide coagulate was filtered through cheesecloth, washed with alcohol (95%) and pressed. Pressed tamarind seed polysaccharide was further dried to constant weight at 35-45°C in hot air oven. Hard tamarind seed polysaccharide cake was ground and sieved through sieve # 20, stored in desiccators for further used [5,6].

Physicochemical Characterization of Tamarind Seed Polysaccharide

Identification Tests for Carbohydrates: As the authors described in previous publication, Extracted gum was mixed with Molish's reagent followed by addition of sulfuric acid. The violet color ring appeared at junction of mixture in test tube that confirms the presence of carbohydrates [6, 7].

Determination of Purity of Tamarind Seed Polysaccharide: For determine purity of extracted tamarind polysaccharide tests for alkaloids, proteins, mucilage, fats, tannins and amino acids were performed as already described by authors in previous publication [6,7].

Organoleptic evaluation of isolated tamarind seed polysaccharide: As authors described elsewhere, isolated tamarind seed polysaccharide was characterized for organoleptic properties such as color, odor, taste, touch, fracture and texture [6].

Solubility Behavior: As already described by author's one part of dry tamarind seed polysaccharide powder was shaken with different solvents and their solubility was determined [6].

Ph of Tamarind Seed Polysaccharide: Firstly, extracted tamarind seed polysaccharide was weighed and then dissolved in water separately to get a 1%w/v solution. The pH of solution was determined using digital pH meter as described by authors in previous publication [6].

Swelling Index: As described by authors in previous publication "swelling index is the volume (in ml) taken up by the swelling of 1 g of test material under specified conditions. The swelling indices of the selected tamarind seed polysaccharide were determined by accurately weighing 1 g of tamarind seed polysaccharides, which was further introduced into a 25 ml glass-Stoppard measuring cylinder. 25 ml of water was added and mixture was shaken thoroughly every 10 min for 1 h. It was then allowed to stand for 3 h at room temperature. Then the volume occupied by tamarind polysaccharide, was measured". The procedure was repeated thrice and the mean value was calculated [8].

Bulk Density and Bulkiness: It has been described by authors that inverse of bulk density is called as bulkiness. As per previous study accurately weighed quantity of (50 g) was introduced into a graduated measuring cylinder. The cylinder was fixed on the bulk density apparatus and the volume occupied by the powder was noted. Then, the powder was subjected to tapping in a bulk density apparatus until constant volume was obtained. The final volume (bulk volume) was noted [6, 9, 10].

True Density: Among various methods available for the determination of true density, liquid displacement method is the simplest method and was used in the

Table 1: *In-situ* floating gel was prepared by using various concentration of tamarind seed polysaccharide such as.

Formulation	Polymer	Sodium alginate	Tri-sodium citrate	Calcium carbonate	Sodium bicarbonate
F1	1%	1%	0.25%	0.5%	-
F2	2%	-	0.25%	0.5%	-
F3	1%	0.125%	0.0625%	-	0.5%
F4	1%	-	0.0625%	-	0.5%

present study. Acetone was selected as the liquid for displacement, because, tamarind polysaccharide is insoluble and heavy in acetone. This method has been used by authors [6, 9, 10].

Powder Flow Property: Flow characteristics were measured by angle of repose as previous publication of authors. Same study was repeated here. Using the readings and the formula, the angle of repose was calculated [6, 9, 10].

Powder Compressibility (Carr's Consolidation Index): This property is also known as compressibility. As described in previous publication finely powdered tamarind seed polysaccharide (5 g) was transferred into a measuring cylinder and calculations were done using bulk density apparatus [6, 9, 10].

Evaluation of Tamarind Seed Polysaccharide as Excipient: Tamarind seed polysaccharide was used to prepare *in-situ* gel forming system for stomach specific drug delivery. Various formulations were prepared as table 1.

Procedure: All the four Formulations were prepared as described below:

Heat the tamarind seed polysaccharide polymer and sodium alginate solution at 60-70ºC

↓

Addition of trisodium citrate in above solution

↓

Decrease the solution below40ºC

↓

Addition of calcium carbonate or sodium bicarbonate to the above solution

↓

Store the solution

RESULTS AND DISCUSSION

It has been observed that isolated tamarind seed polysaccharide was Creamish brown in colour, had no odor or taste along with irregular shape as well as hard and rough in touch and texture. pH of 1% solution was found to be 6.1, which indicated that it should be non-irritating for mucous membrane. Solubility study showed that it was sparingly soluble in cold water, quickly soluble and form viscous colloidal solution in warm water whereas insoluble in ethanol, acetone, benzene, ether and methanol. Swelling index of isolated tamarind seed polysaccharide was found to be 800% the swelling property describe the high swelling ability of the tamarind seed polysaccharide. High swelling of polymer will retard drug release up to desired time period. So it can be used in gel formulations for controlled drug delivery.

Table 2. Determination of purity of isolated tamarind seed polysaccharide

Tests	Present/Absent
Carbohydrates	+
Hexose Sugar	+
Monosaccharides	-
Proteins	-
Fats and oils	-
Tannins and Phenolic Compounds	-
Alkaloides	-
Amino acids	-
Mucilage	-
Gums	-

+ Present; - Absent

The isolated sample was subjected to identification. This showed presence of carbohydrates in sample powder. Confirmation of tamarind polysaccharide was done when it gave negative test for mucilages, gums, tannins, alkaloids and proteins. Other phyto-constituents were absent in the isolated powder. This can be considered as proof for purity of the isolated tamarind seed polysaccharide as depicted in table 2.

Physical characterization of tamarind seed polysaccharide was carried out for angle of repose, Carr's index, true density, bulk density and bulkiness for powder flow behavior where as these properties depends on the particle size, particle size distribution their shape and tendency to adhere together. When angle of repose is less than 30°, then it indicates that powder is free flowing and values greater than 40° suggest a poorly

Table 3. Micromeritic study data of tamarind polysaccharide[#]

Parameters	Values
Angle of repose(0)	29.45±0.12
Carr's index	24.17±1.20
True density(gm/ml)	0.83± 0.04
Bulk density(gm/ml)	0.63±0.03
Bulkiness	1.58±0.072
Hausner ratio	1.03±0.07
Swelling index(%)	800

[#]value with "±" shows standard deviation of triplicate study

flowing powder. When Carr's index values up to 15% generally show good to excellent flow properties of a powder which indicate desirable packing characteristics and when its value above 25% are often sources of poor tableting qualities. So the values lies between these two indices may result in less than the optimum performance and modification of the particle size distribution could be advisable

The bulkiness value indicated that powder is 'heavy in nature. Tamarind seed polysaccharide exhibited good flow characteristics.

Result in table 3 predicts that tamarind seed polysaccharide has good flow, high swelling index. So that TSP can be used as a pharmaceutical excipient.

It was observed from the study that formulation F1 containing 1% tamarind seed polysaccharide as well as 1% sodium alginate formed translucent viscous solution. When solution was poured in to 0.1N HCl (100ml) it formed a gel like structure and came to the surface within 15seconds (floating lag time) and the gel was remained floated on the surface for 2 hours (floating time). F2 containing 2% tamarind seed polysaccharide formed translucent viscous solution. When solution was poured in to 0.1N HCl (100ml) it formed a gel like structure but the gel was not come to the surface. So formulation was unable to float. F3 containing 1% tamarind seed polysaccharide as well as 0.125% sodium alginate formed translucent viscous solution. When solution was poured in to 0.1N HCl (100ml) it formed a gel like structure and came to the surface within 4seconds and the gel was remained floated on the surface for 5minutes. While F4 containing 1% tamarind seed when poured in 0.1N HCl (100ml) formed a gel like structure and came to the surface within 5seconds and the gel was remained floated on the surface only for 3 minutes.

From the study it was concluded that formulation F1 containing 1% tamarind seed polysaccharide as well as 1% sodium alginate was formed a better floating gel system in comparison to the formulation F3 and F4 whereas the formulation F2 containing only 2% tamarind seed polysaccharide was unable to float.

CONCLUSION

it can be concluded from the whole study that tamarind seed derived polysaccharide can be used as a pharmaceutical excipient for oral drug delivery. It has pH value of 6.1, so nonirritant in nature. Polymer was also evaluated for their *in situ* gel forming capacity and result easily predicts the potential for the same. So these polymers have sufficient potential to be used as pharmaceutical excipient in *in situ* gel forming system with sodium alginate and calcium carbonate.

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Conflict of Interest: Authors have no conflict of interest.

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