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Research Article

# ISOLATION AND CHARACTERIZATION OF POLYMER FROM TAMARIND SEED: AN EMERGING EXCIPIENT FOR PHARMACEUTICAL USE

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**A R T I C L E I N F O**

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**A B S T R A C T**

**Background:** To prepare and characterize the polymer from tamarind seed.
**Material and Methods:** Tamarind Seed Polymer extracted by water extraction method
**Results:** It has been observed that isolated tamarind seed polysaccharide shown acceptable properties for pharmaceutical formulations. Swelling index of isolated polysaccharide was found to be 1700%, the swelling property described high swelling ability of tamarind seed polysaccharide. High swelling of polymer will retard the drug release. So it can be used in formulations for controlled drug delivery system.
**Conclusion:** It was found that polysaccharide can be successfully isolated from tamarind seed using water based extraction procedure. Extracted polysaccharide has properties to be used as pharmaceutical excipient. It was also predicted from the study that extracted polysaccharide can be used as a gelling agent, binder etc. in different pharmaceutical preparations.



## INTRODUCTION

Today we have lot of pharmaceutical excipients such as starch, agar, alginate, carrageenan, guar gum, gelatin, pectin, acacia, tragacanth, cellulose, sugars, etc., most of them are from plant origin. [Phani Kumar G.K *et al*, 2011].

Plant derived polymers have mucilage can occur in high concentration in different tremendous interest due to their diveres pharmaceutical application as a diluents, binder, disintegrant in solid dosage forms, thickeners in oral liquid formulations, protective colloidal suspensions, gelling agents in gels and bases in suppositories. [Jharna Bansal *et al*, 2014]. Natural gums are biodegradable and non-toxic, which hydrate and swell on contact with aqueous media. Plant polysaccharide has been useful for the design of specific drug delivery. [Bharath Srinivsasan *et al*, 2011].

Polysaccharides are relatively complex carbohydrates. They provide good mechanical properties for applications as fibers, films, adhesives, rheology modifiers, hydrogels emulsifiers and drug delivery agents. Polysaccharides are widely used in food industry as functional agents. [Anamika Satle *et al*, 2012].

### *Advantages of Natural Polymers*

- ✓ Low cost and natural origin
- ✓ Free from side effects
- ✓ Biocompatible and bio-acceptable
- ✓ Renewable source
- ✓ Environmental friendly process
- ✓ Local availability
- ✓ Better patient tolerance and public acceptance

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## MATERIAL AND METHODS

The seeds of *Tamarindus indica* were purchased from local market, Satara. All the chemicals, solvents and reagents used were of analytical grade procured from Loba Chemical, India.

### *Isolation of Tamarind Seed polysaccharide*

The seeds of *Tamarindus indica* were washed thoroughly with water to remove the adhering materials. Then, the reddish testa of the seeds was removed by heating seeds in sand in the ratio of 1:4 (Seed: Sand). The testa was removed. The seeds were crushed lightly. The crushed seeds of *Tamarindus indica* were soaked in water separately for 24 h and then boiled for 1 h and kept aside for 2 h for the release of mucilage into water. The soaked seeds were taken and squeezed in a muslin bag to remove marc from the filtrate. Then, equal quantity of acetone was added to precipitate the mucilage. The mucilage was separated.

The separated mucilage was dried at temperature 50°C, powdered and passed through sieve number 80. The dried mucilage was powdered and stored in airtight container at room temperature.[Phani Kumar G.K *et al*, 2011].

***Characterization of Selected Polysaccharide***

***Identification test for Selected gum***

The identification of the isolated and purified polysaccharide was confirmed by color reaction with conc. HCL and 5N NaOH. [Phani Kumar G.K *et al*, 2011].

**Determination of purity of gum**

For determine purity of extracted tamarind polysaccharide tests for alkaloids, proteins, fats, amino acids, flavonoids, tannins, saponines, carbohydrates, phenols were carried out. [Jharna Bansal *et al*, 2014].

***Organoleptic Evaluation***

The isolated gum was characterized for organoleptic properties such as color, odor, taste, fracture and texture. [Rupali singh *et al*, 2011].

***Swelling Index***

Swelling index of tamarind seed polysaccharide was determined by using modified method reported. One gram of TSP powder (#100 mesh passed) was accurately weighed and transferred to a 100mL stoppered measuring cylinder. The initial volume of the powder in the measuring cylinder was noted. The volume was made up to 100 mL mark with distilled water. The cylinder was stoppered, shaken gently and set aside for 24 h. The volume occupied by the gum sediment was noted after 24 hr. Swelling index (SI) is expressed as a percentage and calculated according to the following equation,

Swelling index (SI) = Xt-X0 / X0×100

Where, X0 is the initial height of the powder in graduated cylinder and

Xt denotes the height occupied by swollen gum after 24 h.

The content from the measuring cylinder from the above test were filtered through a muslin cloth and the water was allowed to drain completely into a dry 100mL graduated cylinder. The volume of water collected was noted and the difference between the original volume of the mucilage and the volume drained was taken as water retained by sample and was referred to as water retention capacity or water absorption capacity. [Phani Kumar G.K 2011].

***pH of Polysaccharide***

Firstly, extracted tamarind seed polysaccharide was weighed and then dissolved in water separately to get a 1% w/v solution. Then $P^H$ was determined using digital $P^H$ meter. [Jharna Bansal *et al*, 2014].

***Determination of Surface Tension of polysaccharide***

The surface tension of the selected polysaccharides was determined by drop count method, using a stalagmometer. The stalagmometer was filled with purified water above the upper mark. Using the screw pinch cork, the flow rate was adjusted to 10- 15 drops/min. Then, number of drops of water was counted between the marks of the stalagmometer (n1). The water was removed and the stalagmometer was filled with the polysaccharide solution (0.1%w/v) and number of drops was counted (n2). The surface tension of the polysaccharide was determined using formula given below,

Surface tension ($\gamma 2$) = $n2\rho2\gamma1/n2\rho1$

Where, n1=number of drops of water

n2=number of drops of sample

$\rho1$=density of water (0.9956g/mL)

$\rho2$=density of sample

$\gamma1$=surface tension of water (71.18 dynes/cm). [Phani Kumar G.K 2011].

***Solubility***

Solubility of TSP was checked with different solvents and the solubility was determined. [Rupali Singh *et al*, 2011].

***Melting Point***

The melting point of powdered sample of tamarind seed polysaccharide was measured by capillary tube method. [Phani Kumar G.K 2011].

***Powdered flow Properties***

***Determination of Particle size Distribution***

Tamarind seed polysaccharide was dispersed in glycerin and a smear of the dispersion was made and examined under microscope. The sizes of 500 particles were measured using a calibrated eyepiece micrometer. [Phani Kumar G.K 2011].

***Bulk Density and Tapped Density***

The bulk density of tamarind seed polysaccharide was determined by the three-tap method. Weighed quantity of tamarind seed polysaccharide powder was carefully introduced into a 100 mL graduated cylinder. The cylinder was dropped onto a hard wood surface 3 times from a height of 2.5 cm at an interval of 2 seconds. The bulk density was obtained by dividing the weight of the sample by volume of the sample contained in the cylinder (Vi). Tapped density is the ratio of weight of dry powder to its tapped volume. The weighed quantity of dry powder was taken in a graduated cylinder. The volume of powdered bed is measured after each increment of 250 drops until the difference of last two volume measurement is zero. [Phani Kumar G.K 2011].

***Carr's Compressibility Index***

This property is also known as compressibility. Powdered tamarind seed polysaccharide (5 g) was transferred into a measuring cylinder and calculations were done using bulk density apparatus. It can be calculated by following formula, [Phani Kumar G.K 2011; Jharna Bansal *et al*, 2014].

Compressibility index = Tapped Density- Bulk Density / Tapped Density

***Hausner's Ratio***

It was determined by using the Following formula, [Phani Kumar G.K 2011].

Hausner Ratio= Tapped density/ Bulk density

***Angle of Repose***

Flow properties of powder were determined by the angle of repose technique. Angle of repose was determined by the fixed funnel and free standing cone method (Lachman, 1991). A funnel with the end of the stem cut perpendicular to its axis of symmetry was fixed at a given height (h) above the graph paper placed on a flat horizontal surface. The gum powder was carefully poured through the funnel until the apex of the conical pile just touched the tip of the funnel. The radius (r) of the base of the pile was determined and the tangent angle of

repose was calculated by following equation, [Phani Kumar G.K 2011; Jharna Bansal *et al*, 2014].

ɵ= tan-1 h/r

## RESULT

### *Identification tests for Gum*

The polysaccharide from tamarind seeds were purified using water and precipitated with acetone. The percentage yield of mucilage obtained from the seeds of *Tamarindus indica* was found to be 78% (w/w). Characterization of selected polysaccharide

The identification of the isolated and purified polysaccharide was confirmed by colour reaction with conc. HCL and 5N NaOH shown in Table.

**Table 1** Identification tests

| Test | Result |
|---|---|
| Color reaction with conc. HCL | Yellow |
| Color reaction with 5N NaOH | Yellow |

### *Determination of Purity of Gum*

The purity of polysaccharide was determined by prescribed phytochemical tests, which indicated the absence of alkaloids, flavonoids, saponins, tannins. Only carbohydrates were found to be present, which confirms the purity and results as shown in Table

**Table 2** Determination of purity of polysaccharide

| Test | *Tamarindus indica* |
|---|---|
| **Test for flavonoids:** Shinoda test | - |
| **Test for Tannins:** Ferric chloride test, Gelatine test | - |
| **Test for Saponine:** Foam test | - |
| **Test for Carbohydrates:** Molish test, Barfoed's test, Benedict's test | + |
| **Test for Alkaloids:** Mayer's test, Hager's test, Dragendroff's test | - |

**(+Present; -Absent)**

### *Organoleptic Evaluation*

The polysaccharide was characterized by various organoleptic properties such as colour, odour, taste, shape, touch and texture as shown Table.

**Table 3** Organoleptic Evaluation of selected polysaccharide

| Parameter | Tamarind seed polysaccharide |
|---|---|
| Colour | Cream |
| Odour | Odourless |
| Taste | Tasteless |
| Shape | Irregular |
| Touch and Texture | Hard and Rough |

### Physicochemical Characterization of Mucilage

The solubility behaviour of the polysaccharide indicates that it is quickly soluble and forms viscous colloidal solution in warm water, sparingly soluble in cold water, whereas insoluble in ethanol, methanol, acetone and ether. Results were shown in Table.

**Table 4** Solubility behaviour of isolated Tamarind seed polysaccharide

| Solvent | Solubility behaviour |
|---|---|
| Cold water | Sparingly soluble |
| Warm water | Quickly soluble forming a viscous colloidal solution |
| Ethanol | Insoluble |
| Methanol | Insoluble |
| Acetone | Insoluble |
| Ether | Insoluble |

**Table 5** Particle size distribution of tamarind seed polysaccharide

| Size (µm) | Number of Particles |
|---|---|
| 0-30 | 10 |
| 30-60 | 52 |
| 60-90 | 258 |
| 90-120 | 170 |
| >120 | 18 |

**Table 6** Characterization of tamarind seed polysaccharide powder

| Property | Results |
|---|---|
| Bulk density (g/cc) | 0.683 |
| Tapped density (g/cc) | 0.791 |
| Angle of respons (º) | 30.51 |
| Compressibility index (%) | 15.89 |
| Hausner Ratio | 1.06 |
| pH | 6.8 |
| Swelling index (%) | 1700 |
| Surface tension (dynes/cm) | 82.21 |
| Melting point (ºC) | 253 |

## DISCUSSION

The polysaccharide from tamarind seeds were purified using water and precipitated with acetone. The percentage yield of mucilage obtained from the seeds of *Tamarindus indica* was found to be 78% (w/w). The purity of polysaccharide was determined by prescribed phytochemical tests. The solubility behaviour of the polysaccharide indicates that it is quickly soluble and forms viscous colloidal solution in warm water, sparingly soluble in cold water, and insoluble in ethanol, methanol, acetone and ether. Swelling index of isolated polysaccharide was found to be 1700% the swelling property described high swelling ability of tamarind seed polysaccharide. High swelling of polymer will retard the drug release up to desired time period.

## CONCLUSION

In the present study, It can be conclude from the whole study that tamarind seed derived polysaccharide can be used as a pharmaceutical excipient for drug delivery. It has pH value of 6.8, so it is non irritant in nature. It was also predicted from the study that extracted polysaccharide can be used as gelling agent, binder, etc. in different pharmaceutical preparations. The modification of the polymer has increased its applicability in pharmaceutical and food industries. The modified forms can be used in the formulation of tablets, transdermal patches, gels, suspensions etc.

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