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REVIEW ARTICLE

Solubility Enhancement Potential of Tamarind Seed Polysaccharide as Pharmaceutical Excipient

Anamika Satle*, Dr. Shikha Agrawal

Department of pharmaceutics, Swami Vivekanand College of Pharmacy, Indore, M.P, India

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ABSTRACT

In recent years polysaccharides are used widely in food, cosmetic and pharmaceutical industries. The main aim behind their use is to give appropriate texture to the products. Thus the polysaccharides used in such way are some time called as texture modifier. Among hydrophilic polymers, polysaccharides are the choice material for pharmaceutical use due to their nontoxicity and acceptance by regulating authorities. Polysaccharides like xanthan gum, scleroglucan, and gaur gum are some of the natural polysaccharides which have been evaluated in hydrophilic matrix for drug delivery system. Although tamarind seed polysaccharide (TSP) is used as an ingredient in food material and in pharmaceuticals has not been evaluated as hydrophilic drug delivery system. TSP is a galactoxyloglucan isolated from seed kernel of *Tamarindus indica*. It possesses properties like high viscosity, broad pH tolerance and adhesively. This led to its application as stabilizer, thickener, gelling agent and binder in food and pharmaceutical industries. In addition to these other important properties of TSP have been identified recently. They include non-carcinogenicity, biocompatibility, high drug holding capacity and high thermal stability. This led to its application as excipient in hydrophilic drug delivery system. Currently only 8 % of new drug candidates have both high solubility and permeability. More than 60 % of potential drug products suffer from poor water solubility. This frequently results in potentially important products not reaching the market or not achieving their full potential. Development of new excipients is time consuming, involves tedious procedures and is highly expensive. Instead, identification of new uses for the existing substances is relatively inexpensive and less time consuming. Natural polymers have advantages over synthetic and semi-synthetic polymers like low cost, natural origin, less side effects, locally available and better patient tolerance. Since TSP is an important excipient, the present study designed to elucidate the solubility characteristics and dissolution behavior of TSP for water insoluble drugs.

Key words: Tamarind seed polysaccharide (TSP), Galactoxyloglucan, Excipient, solubility.

1. INTRODUCTION

Polysaccharides are a structurally diverse group of biological macromolecules of widespread occurrence in nature. They are composed of repetitive structural features that are polymers of monosaccharide residues joined to each other by glycosidic linkages. In this way they differ structurally from proteins and nucleic acids. Polysaccharides present the highest capacity for carrying biological information since they have the greatest potential for structural variability [15]. 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 the food industry as functional ingredients. Cellulose (*P* 1,4-linked D-glucan) is water insoluble and highly crystalline (*a* 1,4-linked D-glucan) is sparingly soluble in water, crystallizes less well than cellulose, and can form rigid thermoroversible gels at low concentration dextran (*a* 1,C-linked D-glucan) is extremely water soluble and non-gel forming[11]. The reason that polysaccharides can exhibit large differences in solubility, and in their rheological control of the aqueous phase, is because their different primary chemical structures determine the shapes they can adopt in aqueous systems polysaccharide molecular shape, and of the potential polysaccharides have for intermolecular

***Corresponding Author:** Anamika Satle**, Email:** satleanamika@rediffmail.com

interactions, is essential for the understanding and control of rheologicial properties in food applications [16]. TSP is polysaccharide and considered as an exciting and promising excipient for the pharmaceutical industry for present and future applications [16].

Tamarind Seed Polysachharide:

It is a biodegradable polysaccharide extracted from Tamarind seeds (*Tamarandus indica* Linn. Family; *Leguminosae*) called as TSP. *Tamarindus indica* L., commonly known as tamarind tree is one of the most important multipurpose tree species in the Indian sub-continent. It is a large evergreen tree with an exceptionally beautiful spreading crown, and is cultivated throughout almost the whole country, except in the Himalayas and western dry regions [1]. Natural polymers such as TSP have advantages over synthetic and semi-synthetic polymers like low cost, natural origin, less side effects, locally available and better patient tolerance. However, these natural substances suffer with the drawbacks like purity, source and microbial contamination. If these factors can be identified and controlled, natural substance can be good substitute for synthetic polymers [7].

2. Methods of isolation and extraction 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 [1].

3. Chemical composition of tamarind seed polysaccharide

The composition of tamarind kernel, the source of gum, resembles the cereals with

15.4 - 12.7 % Protein, 3 - 7.5 % Oil, 7 - 8.2 % Crude fiber, 61 - 72.2 % Non fiber carbohydrates, 2.45 - 3.3 % Ash. Chemically tamarind kernel powder is highly branched carbohydrate polymer [7]. Its backbone consists of D-glucose units joined with (1-4) b-linkages similar to that of cellulose [13]. It consists of a main chain of b-D- (1-4)-galactopyranosyl unit with a side chain of single xylopyranosyl unit attached to every second, third and fourth of D-glucopyranosyl unit through a-D-(1-6) linkage. One galactopyranosyl unit is attached to one of the xylopyranosyl units through b-D- (1-2) linkage. The exact sequential distribution of branches along the main chain is uncertain [8].

4. General properties of tamarind seed polysaccharide

Purified TSP is a high molecular weight, neutral branched polysaccharide consisting of cellulose like backbone that carries xylose and galctoxylose substances. Chemical residues are similar to that of mucin MUC-1 and Epsialin. It is insoluble in organic solvents and dispersible in warm mater to form a highly viscous gel as a mucilaginous solution with a broad pH tolerance and adhesivity[14]. In addition, it is non-toxic and non-irritant with a haemostatic activity. It is a galactoxyloglucan, belongs to the xyloglucan family, and possesses properties such as Non-newtonian rheological behavior, mucomimetic, mucoadhesive and pseudo plastic properties [10].

5. Physical Properties of tamarind seed polysaccharide

Tamarind kernel powder disperses and hydrates quickly in cold water but does not reach maximum viscosity unless it is heated for 20-30 mins. The solution exhibits typical nonnewtonian flow properties common to most other hydrocolloids. The functional properties of tamarind kernel powder of protein concentrates were reported. The rheological properties of tamarind kernel powder suspension showed that suspension behaved like nonnewtonian, pseudoplastic fluid with yield stresses and exhibited thixotropic characteristics. An increasing concentration produces increase in nonnewtonian behavior as in consistency latex, yields stress and apparent viscosity [11].

6. Pharmaceutical Applications of Tamarind seed polysaccharide

TSP is an interesting candidate for pharmaceutical use, e.g. as a carrier for variety of drugs for controlled release applications. Many techniques have been used to manufacture the TSP-based delivery system which makes it an exciting and promising excipient for the pharmaceutical industry for the present and future applications [7].

6.1. Dissolution improvement:

Tamarind kernel powder is evaluated for its suitability as a carrier to improve the dissolution rate of poorly water-soluble drug Celecoxcib. Influence of polysaccharide concentration and method of preparation of solid mixtures on dissolution rates was investigated. Order of dissolution efficiencies was found to be solvent deposition > cogrinding > kneading > physical mixing > pure celecoxcib[6].

6.2. Binder in tablet dosage form:

Evaluations of tamarind seed polysaccharide as a binder for tablet dosage forms was taken up for the weight granulation as well as direct compression methods. The results indicated that tamarind seed polysaccharide could be used as binder for weight granulation and direct compression tabletting methods [5].

6.3. Colon targeting:

The potential use of TSP as a carrier for colonic drug delivery was demonstrated. They prepared matrix tablets by wet granulation methods using ibuprofen as a model drug. *In vitro* release studies mimicking mouth to colon transit demonstrated the ability of TSP to release the drug at pH 6.8. TSP was remarkably degraded in rat indicating that TSP can be used as a carrier for colonic drug delivery [13].

6.4. Ocular targeting:

TSP is an adhesive enabling it to stick to the surface of eye longer than other eye preparations. TSP possesses mucomimetic, mucoadhesive, and pseudo plastic properties. Furthermore, the TSP drops did significantly better job of relieving several key subjective symptoms of dry eye syndrome namely trouble blinking, ocular burning, and having sensation of having something in someone eye. It also increases the resident time of the drug to the cornea, e.g. Â-blockers. The effect of an ophthalmic preparation containing timolol and TSP on intra-ocular pressure was evaluated in rabbits and found to decrease [8].

6.5. Bioadhesive tablet:

Tablets prepared from the TSP and tamarind gum were evaluated as bioadhesive tablets and was found that the tablets showed longest residence time in oral cavity as compared to that prepared from xanthan gum and carboxycellulose but the unpleasant taste of the former gradually developed[9].

7. Conclusion

The development of novel dosage form of drug delivery systems has resulted in a need for new excipients to support the desired properties. In novel drug delivery systems, polymer plays a vital role. Development of new excipients is time consuming, involves tedious procedures and is highly expensive. Instead, identification of new uses for the existing substances is relatively inexpensive and less time consuming. There has been ever increasing demand for the plant based products as excipients[27]. Natural polymers such as tamarind seed polysaccharide have advantages over synthetic and semi-synthetic polymers like low cost, natural origin, less side effects, locally available and better patient tolerance. However, these natural substances suffer with the drawbacks like purity, source and microbial contamination. If these factors can be identified and controlled, natural substance can be good substitute for synthetic polymers. Natural polymers are used as binding agents, gelling agents, disintegrating agents, sustaining agents in matrix tablets, film forming agents, suspending and emulsifying agents and as solubiliser.

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