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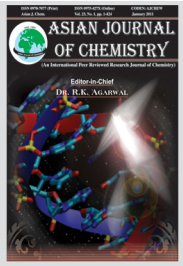

MINI REVIEW

Chemistry and Pharmaceutical Applications of Excipients Derived from Tamarind

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Drug dosage forms contain many components in addition to the active pharmaceutical ingredient(s) to assist in the manufacturing process as well as to optimize drug delivery. Due to advances in drug delivery technology, excipients are currently included in novel dosage forms to fulfill specific functions and in some cases they directly or indirectly influence the extent and/or rate of drug release and absorption. Excipients have been successfully employed in the formulation of solid, liquid and semi-solid dosage forms and are specifically useful in the design of modified release drug delivery systems. Synthetic natural polymers and excipients have been investigated extensively for this purpose, but the use of natural excipients for pharmaceutical applications is attractive because they are economical, readily available, non-toxic, capable of chemical modifications, potentially biodegradable and with few exceptions, and also biocompatible. Of increasing importance is the fact that plant resources are renewable and if cultivated or harvested in a sustainable manner, they can provide a constant supply of raw material. Traditionally, excipients were included in drug formulations as inert vehicles that provided the necessary weight, consistency and volume for the correct administration of the active ingredient, but in modern pharmaceutical dosage forms they often fulfill multi-functional roles such as improvement of the stability, release and bioavailability of the active ingredient, enhancement of patient acceptability and performance of technological functions that ensure ease of manufacture. This mini review discusses the chemistry and potential use of substances derived from Tamarind as multifunctional excipient in various pharmaceutical dosage forms.

Key Words: Pharmaceutical, Excipients, Tamarind.

INTRODUCTION

In recent years there has been a steadily increasing interest in the potentials of the worlds plant resources and many investigators are today busily 'screening' known economical plants for new applications in science and industry. Tamarind has been well known in India since ancient times. *Tamarindus indica* L. is a tropical fruit tree which grows in dry/monsoonal climates. It belongs to the family Leguminosae. Tamarind is a multi-use tree. It is a source of timber, fruit, seeds, fodder and contains medicinal extracts and potential industrial components[1].

The ripe fruit, on an average comprises about: tamarind pulp 55 %, seeds 33 %, fibre 12 %; generally, the chemical constituents of the fresh tamarind varieties were 20.15-24.50 % moisture, 18-48º Brix TSS, 65-77 % total solids, 15.84-20.16 % tartaric acid and 0.68-2.00 % ascorbic acid. Tamarind pulp concentrate is an acceptable product in many countries, since it is easily dispensable and gives a good exotic flavour to certain sources and has higher shelf life than tamarind pulp. A total of 16 volatile flavour components have been identified in this product through gas chromatography[2]. The major constituent of the flavour is aromadendrene (Fig. 1).

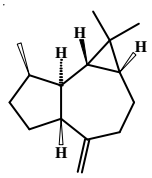

Fig. 1. General structure of aromadendrene

The red pigment (anthocyanin) from the half matured red coloured tamarind fruit (variety-red type) can be obtained (Fig. 2). The chemical constituents of the tamarind powder areisture-5.15 %, acidity-11.52 %, tartaric acid and anthocyanin-1285 mg/100 g.

The seed is the major by product in the tamarind industry. The seed contains about 70% kernel, covered with a hard brown testa. There are three major excipients obtaind from tamarind seed: (i) tamarind kernel powder (TKP); (ii) seed testa; (iii) kernel oil.

Chemical composition and structure of excipients from tamarind

Tamarind kernel powder (TKP): Jellose (Fig. 3) is the major polysaccharide present in the kernel powder (60 %).

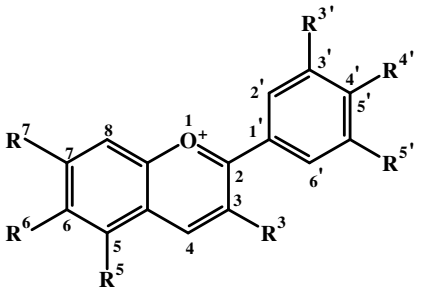

Fig. 2. General structure of anthocyanin

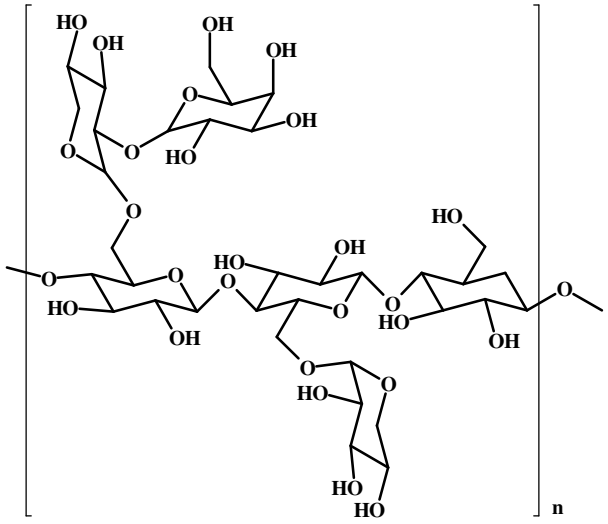

Fig. 3. General structure of jellose

This is composed of D-glucose, D-xylose, D-galactose and L-arabinose in the ratio 8:4:2:1. Tamarind xyloglucan has a (1→4)-β-D-glucan backbone that is partially substituted at the O-6 position of its glucopyranosyl residues with α-D-xylopyranose. Some of the xylose residues are β-D-galactosylated at O-2[1].

Jellose can be used as an excellent substitute for fruit pectins and it can be used as an effective remedy against diarrhoea, dysentery and colitis. Other uses are in the cosmetics, pharmaceutical and insecticidal preparations.

Seed testa: The seed testa the residual product in the preparation of kernel powder used as a dyestuff due to presence of leucoanthocyamins and also as a plywood adhesive (Fig. 4). The testa contains crude fibre (21.6 %), fibre (7.4 %) and tannins (20-24 %), the major group being lecucoanthocynidin. Tannins from seed testa are black in colour and highly polymeric. Seed coat extract of tamarind possess antioxidative property.

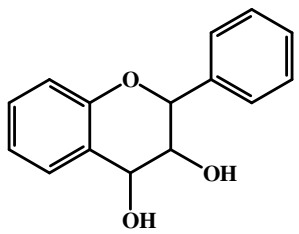

Fig. 4. Chemical structure of leucoanthocyanidin

Kernel oil: Seed kernel contains 6-8 % oils. The fatty acids present are linoleic acid (46.4 %), oleic acid (27.2 %) and saturated fatty acid (26.4 %). The kernel oil also contains sterols, the major ones being β-sitosterol (66- 72 %), campestral (16-19 %) and stigmasterol (11-14 %). It can be used as a semisolid base for pharmaceutical preparations.

General properties of tamarind jellose: Purified tamarind seed jellose is a high-molecular-weight, neutral branched polysaccharide consisting of cellulose like backbone that carries xylose and galctoxylose substances[3]. Chemical residues are similar to that of mucin MUC-1 and epsialin[4]. It is insoluble in organic solvents and dispersible in warm water to form a highly viscous gel as a mucilaginous solution with a broad pH tolerance and adhesivity. 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 behaviour, mucomimetic, mucoadhesive and pseudo plastic properties[5-7].

Pharmaceutical applications: 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 tamarind seed polysaccharide-based delivery system which makes it an exciting and promising excipient for the pharmaceutical industry for the present and future applications.

Evaluations of tamarind seed polyose as a binder for tablet dosage forms was taken up for the wet granulation as well as direct compression methods. The results indicated that tamarind seed polyose could be used as binder for wet granulation and direct compression tableting methods[7].

Tamarind seed jellose can be used for production of thickened ophthalmic solutions having a pseudoplastic rheological behaviour and mucoadhesive properties. In the literature it is reported that the solution was used as artificial tear and as a vehicle for sustained release ophthalmic drugs. The concentrations of jellose preferably employed in ophthalmic preparations for use as artificial tears, *i.e.* products for replacing and stabilizing the natural tear fluid, particularly indicated for the treatment of dry eye syndrome were comprised between 0.7 and 1.5 % by weight. The concentrations of tamarind polysaccharides compromised between 1 to 4 % by weight is preferably employed in the production of vehicles (*i.e.* delivery system) for ophthalmic drugs for prolonging the prevalence time of medicaments at their site of action[8].

Tamarind seed polysaccharide was used for ocular delivery of 0.3 % antibiotics in the treatment of experimental *Pseudomonas aeruginosa* and *Staphylococcus aureus* keratitis in rabbits. The polysaccharide significantly increased the intraocular penetration of antibiotics in both infected and uninfected eyes. Polysaccharide allowed sustained reduction of *S. aureus* in cornea that could be achieved even when the time interval between drug administrations was extended. The results suggested that tamarind seed polysaccharide prolongs the precorneal residence time of antibiotic and enhanced the drug accumulation in the cornea, probably by reducing the washout of topically administered drugs[9].

Sumathi and Ray[10] used tamarind polysaccharide matrix former as it has high holding capacity for sustained release of water soluble and water insoluble drugs. The release pattern

was found to be comparable with matrices of other polysaccharide polymers such as ethyl cellulose, hydroxyethyl cellulose and hydroxypropylmethyl cellulose, as well as the commercially available sustained release tablets.

The potential use of tamarind jellose as a carrier for colonic drug delivery was demonstrated[11]. The researchers 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 polyose to release the drug at pH 6.8. Tamarind polyose was remarkably degraded in rat indicating that tamarind polyose can be used as a carrier for colonic drug delivery[11].

Tablets prepared from the tamarind jellose 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[12] but the unpleasant taste of the tamarind gum gradually developed. Tamarind jellose was used as release modifier for the preparation of microparticle. It was observed that release was sustained over a period of 7.5 h. A credible correlation was obtained amongst swelling index, viscosity and surface roughness of the polysaccharide particles and *in vitro* dissolution profile of microprticle and spheroids. In the comparative bioavailability study, the developed microparticle and spheroids have been able to sustain drug release and also were found to improve the extent of absorption and bioavailability of drug[13] .

Tamarind xyloglucan is permitted as a thickening, stabilizing and gelling agent food industry. Although tamarind xyloglucan itself does not form a gel. The gel can be obtained under appropriate conditions, such as by adding some substances or removing substituents. Tamarind xyloglucan forms a gel in the presence of 40-65 % sugar over a wide pH range. It also forms a gel in the presence of alcohol or by removing galactose residues from tamarind xyloglucan[14]. The gelling property of the tamarind polysaccharide make it possible to form a film.

General properties of tamarind seed testa: The testa is reported to contain 40 % water solubles, 80 % of which is a mixture of tannin and colouring matter[15]. In the production of tamarind kernel powder (TKP) or the jellose, large quantities of testa are left as a residual by-product. The use of testa in dyeing and tanning has been suggested. Similarly, several authors[16] have suggested that seed coat, a by-product of tamarind gum industries can be used as a safe and low-cost antioxidant for increasing the shelf-life of foods by preventing lipid peroxidation. However it has not been explored either as a coloring agent or antioxidants for pharmaceutical preparations.

General properties of tamarind kernel oil: The fatty acid composition (% by wt) of tamarind (*Tamarindus indica*) kernel oil, as determined by gas liquid chromatography was: trace lauric acid, trace myristic acid, 14.8 % palmitic acid, 5.9 % stearic acid, 27.0 % oleic acid, 7.5 % linoleic acid, 5.6 % linolenic acid, 4.5 % arachidic acid, 12.2 % behenic acid, and 22.3 % lignoceric acid[17]. Kernel oil, the presence of fats and sterols attributed to be used as a semisolid base for pharmaceutical preparations[18] .

Derivatized tamarind seed jellose: Carboxymethylated tamarind (CMT) has been synthesized by reacting tamarind kernel powder (TKP) with sodium salt of monochloro acetic acid (SMCA) in the presence of sodium hydroxide. The material thus developed was studied for its suitability as a matrix for controlled drug delivery. Carboxymethylation of tamarind kernel powder increased its solubility in cold water and the stability of its paste to microorganisms.

Two-step preparation and the characterization of composite gel beads of tamarind gum (2.0 wt %) and sodium alginate (0.6 wt %) as spherically well shaped forms are reported. The results have demonstrated that the composite gel beads not only have the advantages of rather rough surface, three-dimensionally network structure, and high anti-acid and anti-alkali properties. They are not prone to breakage under load. The composite gel beads prepared are potentially useful as polymeric carriers or supports in biotechnology and biochemistry applications[19].

Future perspective and applications: The literature shows wide application of tamarind as excipient in various drug delivery systems used in pharmaceutical industry but more in food industry. In pharmaceutical research, so far, the research is being focussed on tamarind jellose and its applications, but the other tamarind plant derived substance has the potential to become pharmaceutical excipients. However, they has to be obtained in the purest form by the easiest methods so that they can be used readily as for both the commercial and pharmaceutical use.

REFERENCES

1. V. Gupta, R. Puri, S. Gupta, S. Jain and G.K. Rao, *Syst. Rev. Pharm.*, **1**, 50 (2010).
2. D.Y. Jhadav, A.K. Sahoo, J.S. Ghosh, R.C. Ranveer and A.M. Mali, *Internat. J. Trop. Med.*, **5**, 68 (2010).
3. M. Khanna, Polyose from Seeds of *Tamarindus indica* of Unique Property and Immense Pharmaceutical Use and Trends in Carbohydrates Chemistry, Dehradun, India, Surya International Publications, Vol. 4, pp. 79-81 (1997).
4. J. Hilkens, M.J. Ligtenberg, H.L. Vos and S.V. Litvinov, *Trends Biochem. Sci.*, **17**, 359 (1992).
5. D. Kulkarni, *Indian J. Pharm. Sci.*, **59**, 1 (1997).
6. M. Rolando and C. Valente, *BMC Ophthalmol.*, **7**, 5 (2007).
7. D. Kulkarni, A.K. Dwivedi and S. Singh, *Indian J. Pharm. Sci.*, **60**, 50 (1998).
8. E. Ghelardi, A. Tavanti, F. Celandroni, A. Lupetti, C. Blandizzi, E. Boldrini, M. Campa and S. Senesi, *J. Antimicrob. Chemother.*, **46**, 831 (2000).
9. E. Ghelardi, A. Tavanti, P. Davini, F. Celandroni, S. Salvetti, E. Parisio, E. Boldrini, S. Senesi and M. Campa, *Antimicrob. Agents Chem.*, **48**, 3396 (2004).
10. S. Sumathi and A.R. Ray, *Trends Biomater. Artif. Organs*, **17**, 41 (2003).
11. M.U. Mishra and J.N. Khandare, Tamarind Seed Polysaccharides: Biodegradable Polymer for Colonic Drug Delivery. Second International Conference and Indo-Canadian Satellite Symposium on Pharmaceutical Science, Technology, Practice and Natural Products, Conference Chronicle, DDS; 35:206 (2007).
12. R. Datta and A.K. Bandopadhyay, *Saudi Pharm. J.*, **14**, 115 (2006).
13. G.T. Kulkarni, K. Gowthamarajan, D. Rohan and B. Suresh, *Drug Deliv.*, **12**, 201 (2005).
14. J. Zhang, S. Xu, S. Zhang and Z. Du, *Iran. Polym. J.*, **17**, 899 (2008).
15. FRI, Tamarind Seed has Many Uses, *Indian Farming*, **8**, 21 (1955).
16. P.S. Rao and H.C. Srivastava, Tamarind: In Industrial Gums, Academic Press, New York, pp. 370-441 (1974).
17. P.M. Pitke, P.P. Singh and H.C. Srivastava. *J. Am. Oil Chem. Soc.*, **54**, 592 (1977).
18. J. Viyoch, N. Klinthong and W. Siripaisal, *Naresuan Univ. J.*, **11**, 29 (2003).
19. S. Pal, G. Sen, S. Mishra, R.K. Dey and U. Jha, *J. Appl. Polym. Sci.*, **110**, 392 (2008).