Available online on 15.10.2018 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Research Article

PREPARATION AND EVALUATION OF MODIFIED TAMARIND SEED GUM AS A NOVEL SUPERDISINTEGRANT

Dhruv Dev*, Diksha Kumari Rehal, DN Prasad

Shivalik College of Pharmacy, Nangal, Punjab, India

ABSTRACT

The aim of present study was to preparation and evaluation of modified *Tamarind seed* as natural superdisintegrant. The extracted gum from the *Tamarind seed* was modified chemically by carboxymethylation of extracted gum was done to improve the hydrophilic nature of the gum. Further, carboxymethylated gum was complexed by using calcium chloride to enhance the wetting capacity of the gum. The modification in functional group of extracted gum, carboxymethyled gum, Calcium complexed gum was studied by FT-IR spectrophotometer. The DSC studies shows that the changes in melting point of the carboxymethyled gum and the calcium complexed gum as compared to the extracted gum without undergoing chemical modification. The modified gum was then subjected to different studies like color, pH of gum solution, swelling indexetc. The dummy tablet prepared with calcium complexed modified Tamarind seed gum to check its disintegration effect of the tablet. The various pre-compression parameters of the tablet blend was determined like bulk density, tapped density, Carr's index, angle of repose and Hausner's ratio. The disintegration time of these dummy tablet carry the calcium complexed tamarind seed gum was compared to formulate tablet with marketed superdisintegrant i.e. sodium starch glycolate . The disintegration time of calcium complexed Tamarind seed gum was observed to be 1 min. approx. 32.5 sec. 35.2 sec. showing good disintegrating property. It can be concluded that Fast disintegrating tablet using modified *Tamarind seed* gum as natural superdisintegrant improves the disintegration time of the tablet.

Keywords: FDT tablet, Tamarind seed gum, Sodium starch glycolate, Swelling time.

Article Info: Received 02 Sep, 2018; Review Completed 12 Oct 2018; Accepted 12 Oct 2018; Available online 15 Oct 2018

Cite this article as:

Dev D, Rehal DK, Prasad DN, Preparation and evaluation of modified tamarind seed gum as a novel superdisintegrant, Journal of Drug Delivery and Therapeutics. 2018; 8(5-s):372-377

DOI: http://dx.doi.org/10.22270/jddt.v8i5-s.1994

***Address for Correspondence:**

Dhruv Dev, Shivalik College of Pharmacy, Nangal, Punjab, India

INTRODUCTION

Disintegration showed an important role in enhancing the drug action and also increases the patient compliance.[1] The disintegration and dissolution also depend upon the therapeutic response of the formulation. In the drug formulation the addition of disintegrating agent which enhances the diffusion and rupture of tablet and capsule into little molecule for rapid dissolution.[2] Solid dosage form like ODT's tablet and orally dissolving, chewable tablet that is dissolve and disintegrate quickly in the mouth absence of water[3]. In the tablet formulation the several main constituent are added into it, which help us to rupture the tablet or capsule into smaller molecule and thus are known as superdisintegrant[4]. They help in quick release of the drug from the tablet or capsule. Superdisintegrant are the substances that enhance the faster disintegration the formulation in the lesser quantity. Superdisintegrant generally shows water uptake rate higher than the swelling rate of disintegrant are also higher[5]. Now days the most effective agent are used at low concentration in the solid dosage form about 1-10% superdisintegrant[6]. They are effective in low concentration and have greater disintegrating capacity on contact with water superdisintegrants swell, change the volume and disruption of the tablet**.** Examples:- Natural Superdisintegrant:- Gellan gum, Isapghula husk mucilage's, Chikle gum, Locust bean gum, Lepidium sativum seed mucilage, Tamarind seed gum, Cassia fistula, Jackfruit seed gum. Synthetic Superdisintegrant:- Modified starch (sodium starch glycolate), Primojel,

chitin, alginates, calcium silicate, cross linked PVP, cross linked starch, cross linked alginate [7]. Therefore, In this study deals with a novel idea of preparing superdisintegrant from Tamarind seed gum. *Tamarind* or *Tamarindus indica* L. family belongs to Leguminosae (Fabaceae) [8]. They are used as a superdisintegrating agent in this study. The carbohydrate portion contains Glucose, Glactose, Xylose, Xylopyranose, Galactopyranosyl, Glucuronic acid, Galacturonic acid[9]. *Tamarind* is used to treat in diarrhoea and dysentery effectively. It is used to enhance the immunity. They have anti-inflammatory property and also used to lowers blood sugar level[10]. The carboxylic nature of gum is important for the disintegration activity. Tamarind seed gum was modified chemically to enhance its disintegration property [11]. Futher, the carboxymethylated gum was complexed using calcium chloride so as to enhance the absorption capacity of the gum. This would easily dissolve the formulation and enhances faster drug release. Tamarind fruit are also used in herbal medicine.

MATERIAL AND METHOD

Tamarind seed were obtained from the fruits of tamarind purchased from local market. Sodium Chloride, Calcium chloride, Monochloroacetic acetic acid, were obtained from Thermo Fischer Scientific India, Pvt. Ltd., Mumbai. Alcohol and isopropyl alcohol were obtained from Avantor Performance Material India Ltd. Gujarat. Erichrome black-T and EDTA were obtained from Himedia laboratories Pvt. Ltd, Mumbai.

Preparation of superdisintegrant from modified tamarind seed gum

1. Extraction of the gum from modified tamarind seeds: Gum is extracted from modified Tamarind seeds. Extraction was done by crushing the seeds of Tamarind seed in the mortar pestle. The crushed material was then transferred to the 1000ml beaker and boiled in 500 ml of distilled water for 5-6 hrs. After complete boiling of the crude material, filtered using a muslin cloth. The filtered was the concentrated by boiling for 2-3 hrs using water bath. The concentrate was then cooled and alcohol was added till the formation of precipitates. The precipitates were separated out using vacuum filtration apparatus. The precipitates were dried under the sunlight[12].

2. Preparation of carboxymethyled modified tamarind seed gum (CMTG): Carboxymethylation of Tamarind gum was done from Tamarind seed gum. An aqueous dispersion of Tamarind seed gum (1.25%, W/V) in the ice cold sodium hydroxide (45%,W/W), was prepared by stirring for 30 min. To this 25 ml of aqueous solution of monochloroacetic acid (45%, W/V) was added with constant stirring. The reaction mixture was then heated to 70^0C under constant stirring for 30 min., cooled and suspended into (80%,V/V) methanol precipitates of CMTG so formed were filtered and neutralized with glacial acetic acid, followed by washing with portions of methanol (80%,V/V), filtration, and drying in an oven at 40^0C. [13]

3. Calcium complexation of the carboxymethylated tamarind seed gum (CMTG): The preparation of calcium cross linked gum derivatives done by reacting the respective derivative with calcium chloride. 2.5 g of carboxymethyled gum was dissolve in 50 ml of water calcium chloride (5%, W/V,50 ml) solution in water was added drop wise to the gum calcium chloride solution mixture with stirring to obtain thick, uniform and gelatinous precipitates. These precipitates were repeatedly washed with distilled water to remove unreacted calcium and gum. The washing was stopped when the filtrate did not yield red color from blue color after adding it to standard magnesium-EDTA complex solution containing Erichrome black T indicator solution. These washed precipitates were freeze dried and then passed through # 80 sieve [14,15].

Figure 1: Extracted Pure Tamarind seed gum

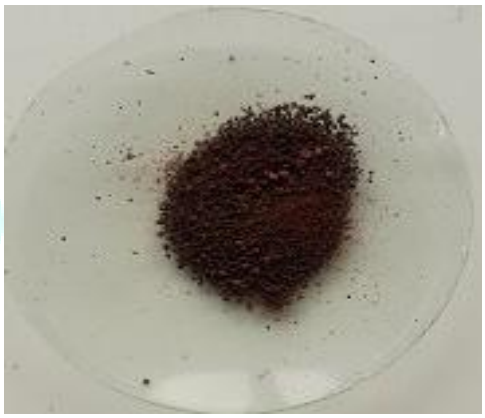

Figure 2: Carboxymethyled Tamarind seed gum

Figure 3: Calcium complexed Tamarind seed gum

Characterization of the superdisintegrant:

pH of the gum solution: The pH of the gum solution was determined for 1% w/v solution of the gum in distilled water.

Melting Point: Melting point of pure Tamarind seed gum was determined by capillary tube method and the melting point found to be 240^0C-260^0C.

Swelling Index: Swelling index is describes as the amount of water absorbed by the gum when placed in water for a fixed time. It gives the % of weight achieve by the gum after absorbing water[16].

$$\text{Swelling index} = \frac{\text{Final weight of the gum} - \text{Initial weight of the gum}}{\text{Initial weight of the gum}} \times 100$$

FT-IR Studies: FT-IR studies were carried out for simple gum, modified gum and the calcium complexed gum to ascertain the change in functional groups in structure of gum by Perkin Elmer FTIR.

DSC Studies: DSC studies disclose that the melting point of pure Tamarind seed gum, modified gum and the calcium complexed gum to ascertain change in internal structure of the gum.

Formulation of dummy tablet containing tamarind seed gum as natural superdisintegrant:

Pre-compression parameters:

Bulk density: Apparent bulk density ρ_b was determined by pouring the blend into a graduated cylinder. The bulk volume (V_b) and weight of powder (M) was determined. The bulk density was calculated using the formula

$$\rho_b = \frac{M}{V_b}$$

Tapped Density: The measuring cylinder containing a known mass of blend was tapped for a fixed time. The minimum volume (V_t) occupied in the cylinder and the weight (M) of the blend was measured. The tapped density (ρ_t) was calculated using the formula

$$\rho_t = \frac{M}{V_t}$$

Carr's Index: The simplest way for measurement of flow of powder is its compressibility, an indication of the ease with which a material can be induced to flow is given by carr's index (I) which is calculated as follows

$$I = \frac{\rho_t - \rho_b}{\rho_t} \times 100$$

Hausner's Ratio: Hausner's ratio (HR) is an indirect index of ease of powder flow. It is calculated by the following formula.

$$HR = \frac{\rho t}{\rho b}$$

Angle of Repose: Angle of repose was determined using funnel method. The blend was poured through a funnel that can be raised vertically until a specified cone height (h) was obtained. Radius of the heap (r) was measured and angle of repose (θ) was calculated using the formula [17].

$$Tan\theta = \frac{h}{r}$$

Formulation of fast disintegrating tablets:

The Calcium complexed Tamarind seed gum is used as a natural superdisintegrant for the formulation of the dummy FDT's tablets. These dummy tablet carrying the natural superdisintegrant were compared to the marketed superdisintegrant / synthetic superdisintegrant (Sodium Starch glycolate) for disintegration time.

Formulation of dummy tablet using calcium complexed tamarind seed gum as superdisintegrant [18]

Dummy tablet prepared using Calcium complexed Tamarind seed gum and sodium starch glycolate in 10 batches i.e F1to F10 with varying amount of both superdisintegrants as shown in table 1:

Table 1: Different batches of Dummy Tablets

Formulation	MCC (mg)	Lactose (mg)	Calcium Complexed Tamarind seed gum (mg)	Sodium Starch Glycolate (mg)	Magnesium stearate (mg)	Talc (mg)
F1	100	43.5	2.5	-	2	2
F2	100	41	5	-	2	2
F3	100	38.5	7.5	-	2	2
F4	100	36	10	-	2	2
F5	100	33.5	12.5	-	2	2
F6	100	43.5	-	2.5	2	2
F7	100	41	-	5	2	2
F8	100	38.5	-	7.5	2	2
F9	100	36	-	10	2	2
F10	100	33.5	-	12.5	2	2

Evaluation of the tablets containing different superdisintegrant for their disintegration time

The prepared tablets were subjected to various evaluations like weight variation, friability, content uniformity, hardness and disintegration studies. [18]

RESULT AND DISCUSSION

The pH of modified gum was found to be 5.4.

The swelling index of the gum was found to be 298%

IR spectra for pure gum showed peaks at 3425 cm^{-1} , 2931.8 cm^{-1} confirmed the presence of hydroxyl group and carboxyl group in the gum. FT-IR spectra of Pure Tamarind seed gum shown in Fig. 4.

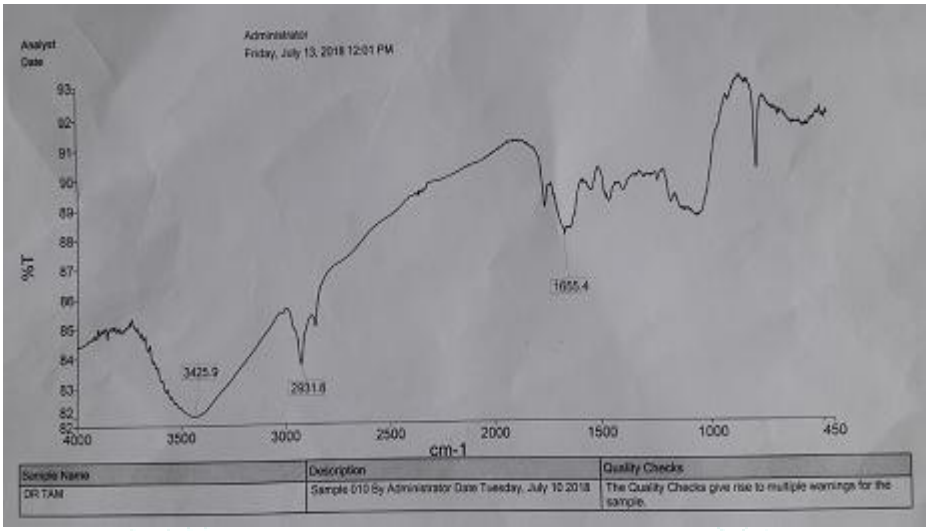

Figure 4: FT-IR of Pure Tamarind seed gum

Then upon carboxymethylation of extracted seed gum, the property of the gum was modified by the addition of methyl group. After modification by carboxymethylation, the peak shifts from 2931.8 to 2911.43 cm^{-1} showing presence of methyl group, and the addition of methyl group to enhance the hydrophillic nature. FT-IR spectra of Carboxymethyled Tamarind seed gum shown in Fig.5

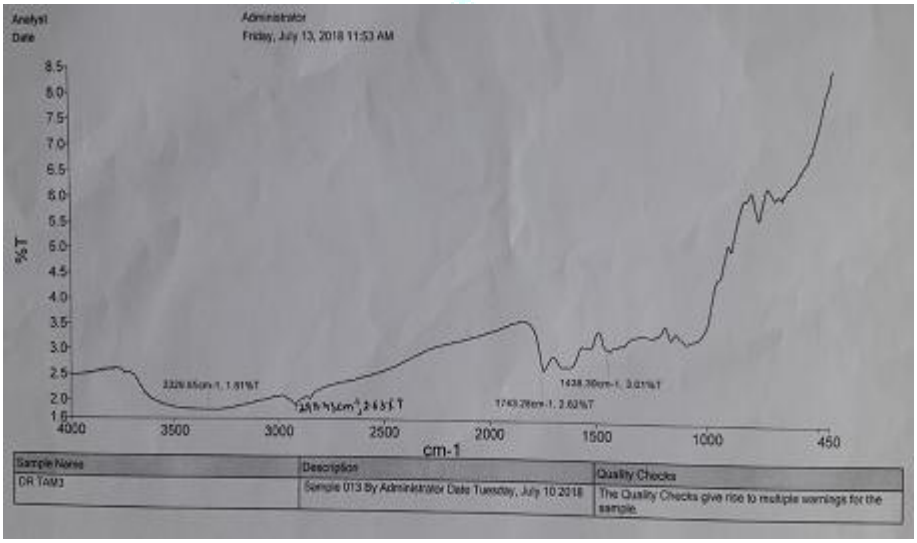

Figure 5: FT-IR of Carboxymethyled Tamarind seed gum

It was further complexed with Ca^{2+} ion to enhance its swelling nature. The carboxymethyled seed gum (COO^- CH-) was reacted with calcium chloride. Then the product obtained i.e. COO^-Ca^{2+}. In this reaction the -CH- group was replaced by Ca^{2+}. They shows that the IR peak towards carbonyl group i.e. -C-OH group at 1044.14 cm^{-1}. The carboxylic acid peak at 3400.00 cm^{-1}. FT-IR spectra of Calcium complexed Tamarind seed gum shown in Fig. 6

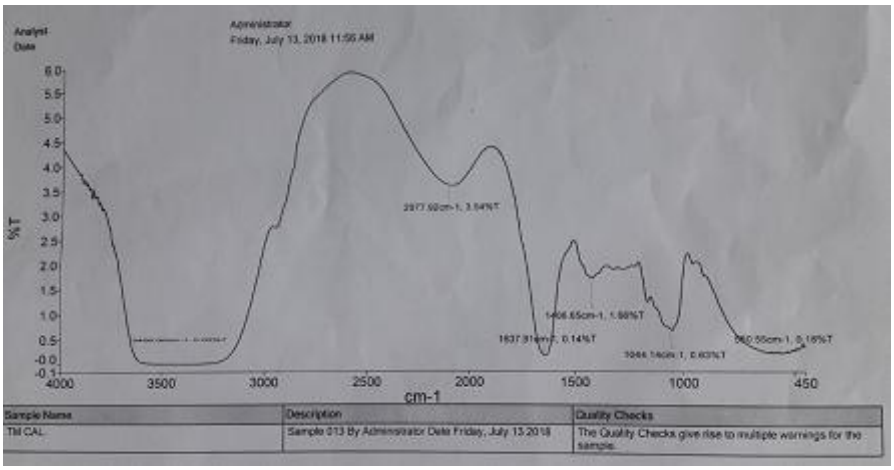

Figure 6: FT-IR of Calcium complexed Tamarind seed gum

DSC of Pure Tamarind seed gum shown in Fig. 7

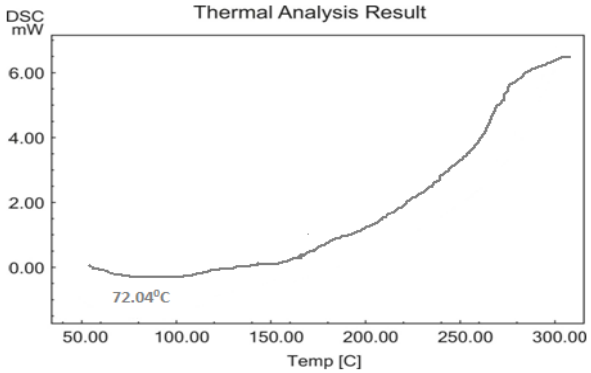

Figure7: DSC of Pure Tamarind seed gum

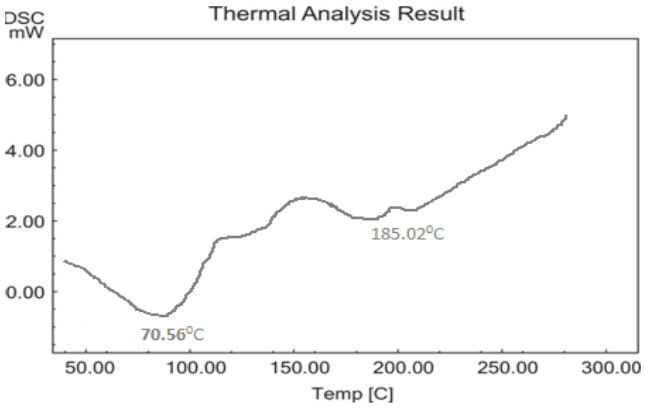

Figure 8: DSC of Carboxymethyled Tamarind seed gum

The carboxymethylation of the Tamarind seed gum, A sharp endothermic peak was found at 70.56°C, due to the heat produce during reaction process a small endothermic peak was also found at 185.02°C. DSC of Carboxymethyled Tamarind seed gum shown in Fig. 8

After calcium complexation of carboxymethyled Tamarind seed gum shifts the endothermic peak towards 68.22°C, the exothermic peak was observe to be 267.23°C. DSC of Calcium complexed Tamarind seed gum shown in Fig. 9

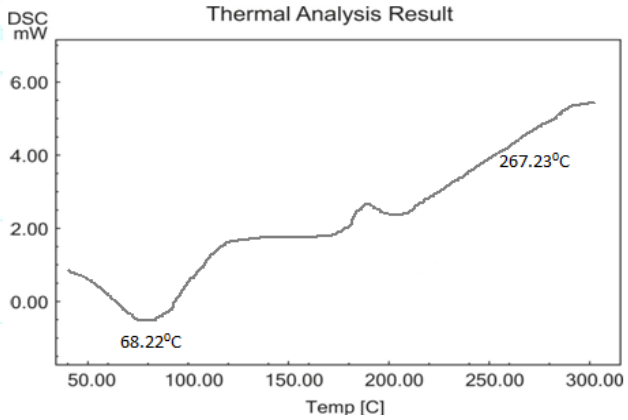

Figure 9: DSC of Calcium complexed Tamarind seed gum

Pre-Compression parameters of the blend of the powders used for the formulation of the tablet by calcium salt of modified tamarind gum was noted in Table 2.

Table 2: Pre-Compression parameters for different blends of powder by using modified gum

S.No.	Bulk density	Tapped density	Carr's index	Angle of repose	Hausner's ratio
1.	0.44	0.47	22.16	29.37	1.43
2.	0.39	0.54	23.57	35.13	1.51
3.	0.41	0.61	25.42	25.76	1.23
4.	0.37	0.43	18.42	38.64	1.36
5.	0.46	0.67	16.74	39.83	1.41

The hardness of all the batches range from 4.2 to 5.4 kg. Friability varies from 0.69% to 1.1%. Drug content uniformity was 98% to 99.94%. Weight variation is also within limit.

The Disintegration apparatus was used to determine the Disintegration time of the dummy tablet containing Calcium complexed Tamarind seed gum and Sodium starch glycolate. The results of disintegration time for different formulation were reported in table 3.

Table 3: Disintegration time for different formulations

Formulation	Disintegration Time (s)
F1	46±2s
F2	44± 6s
F3	35± 2s
F4	37±5s
F5	37±3s
F6	48± 3s
F7	45 ±8s
F8	41±7s
F9	44 ±3s
F10	39±2s

The results the Disintegration test showed that the formulation F3 containing Calcium complexed Tamarind seed gum disintegrate in shortest period as comparison to other preparations.

CONCLUSION

The present investigation study revealed that the great superdisintegration potential of modified Tamarind seed gum. The FDT's tablet prepared from calcium complexed Tamarind seed gum (7.5%) showed faster disintegration of tablet as compared to the synthetic superdisintegrant (Sodium starch glycolate). The carboxymethylation of the Tamarind seed gum is used to increase the hydrophillicity to the gum, so that it can easily disintegrate in the gastric fluid. Further, the carboxymethyled gum was complexed with Ca^{2+} that forms the calcium complex gum. Therefore, the calcium complexed Tamarind seed gum shows better superdisintegrant that provide FDT's with good mechanical strength and lowest disintegration time. This superdisintegrant are used in the future time for the formulation and development of FDT's tablet.

ACKNOWLEDGMENTS

The author wishes to acknowledge the Principal, Shivalik college of Pharmacy, Nangal for providing the chemicals and infrastructure and also Registrar, IKG Punjab Technical University, Jalandhar, Punjab.

CONFLICT OF INTEREST

The author does not have any conflict of interest.

REFERENCES

1. Amaliyar PR, Patel H, Chaudhary SA, Shah H, Patel A. A brief review on natural and synthetic superdisintegrant. Inventi journal. 2014; 3:1-6
2. Shihora H, Panda S. Superdisintegrants, utility in dosage form: A quick review. JPSBR. 2011; 3(1): 148-153.
3. Shrivastava P, Sethi V.A review article on: Superdisintegrants. International Journal of Drug Research and Technology. 2013; 3(4):76-87.
4. Gohel MC, Parikh RK, Brahmbhatt BK, Shah AR. Prepartion and Assesement of Novel Co-processed Superdisintegrant consisting of crosspovidone and sodium starch glycolate: A Technical Note. AAPS Pharm Sci Tech. 2007; 8(1):1-6.
5. Lopez-solis L, Villafurerte-Robles L. Effect of Disintegrants with different hygroscopicity on dissolution of Norfloxacin/ Pharmatose DCL 11 tablets. International Journal of Pharmaceutics. 2001; 127-135.
6. Rawat S, Derle D V, Sulbha R F, Shinde P R, Parve B S. Superdisintegrants: An overview. World Journal of Pharmacy and Pharmaceutical Sciences. 2014; 3(5):263-278.
7. Mohanchandran PS, Sindhumol PG, Kiran TS. Superdisintegrants: An Overview. International Journal of Pharmaceuitcal Science Review and Research. 2011; 6(1):145-152.
8. Mukesh CG, Rajesh KP, Bansari KB, Aarohi RS. Prepartion and Assessment of Novel Co-processed Superdisintegrant consisting of crosspovidone and sodium starch glycolate. AAPS Pharm Sci Tech. 2007; 8:1-7.
9. Mohamed HA, Mohamed BE, Ahmed KE. Physicochemical Properties of Tamarind (Tamarindus indica) Seed polysaccharide. Journal of Food Procesing and Technology. 2015; 6(6):1-5.
10. Bhusari SN, Muzaffar K, Kumar . Effect of Carrier agents on Physical and Microstructral Properties of Spray dried Tamarind pulp powder technology. 2014; 266:354-364.
11. Surati B I, Minocheherhomji F P. Benefits of Tamarind Kernal Powder- A natural Polymer. IJAR, 2018; 54-57.
12. Singh R, Malviya R, Sharma P K. Extraction and Characterization of Tamarind seed Polysaccharides as a polysaccharide excipient. Pharmacognosy Journal. 2011; 3(20):17-19.
13. Mali K K, Dhawale S C. Design and optimization of Modified Tamarind Gum-Based Floating Bioadhesive tablets of Verapamil Hydrochloride. Asian Journal of Pharmaceutics. 2016; 10(4):239.
14. Ahuja M, Singh S, Kumar A. Evaluation of Carboxymethyl gellan gum as a mucoadhesive polymer. International Journal of Biological Macromolecules. 2013; 53:114-121.
15. Rai P R, Tiwari A K, Rana V. Superior disintegrating properties of calcium cross linked cassia fistula gum derivative for fast dissolving tablet. Carbohydrate polymers. 2012:1098-1104.
16. Ponikornkit B, Ngamsalak C, Hunbutta K, Sittikijyothin W. Swelling behaviour of Carboxymethylated Tamarind gum. Advanced Material Research. 2014; 1060:137-140.
17. Immadi H P, Kala S L J, Rao K S, Manikiran S S, Rao N R. IJPPR. 2017; 10(2):121-138.
18. Pawha R, Gupta N. Superdisintegrant in the development of orally disintegrating tablets: A Review. IJPSR. 2011; 2(11):2767-2780.