Research Article

Isolation and characterization of natural and modified seed gum

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Abstract

Objective: The objective of the present work was to investigate the film coating potential of Fenugreek seed gum (FSG), Tamarind seed gum (TSG), using paracetamol as a model drug. **Materials and Methods:** Fenugreek seed gum (FSG), tamarind seed gum (TSG), paracetamol tablets, hydroxypropylmethylcellulose (HPMC) and sodium alginate (SA). Core tablets of paracetamol were obtained from a pharmacy shop in the local market and were evaluated for weight, diameters, thickness, hardness, friability, and disintegration time. The core tablets were coated using 2% w/v solution of TSG, MTSG, FSG, MFSG and the *in-vitro* release rate of drug from these coated tablets was compared to the release rate of drug from the tablets coated with 2% w/v of HPMC. **Results:** The tablets coated with natural and modified tamarind seed gum, separately. The coated tablets are release the drug up to 10 hrs and 11 hrs, respectively and natural and modified fenugreek seed gum release the drug up to 7 hrs and 9 hrs respectively. The tablets coated with HPMC released the drug up to 14 hrs. The drug release profile of tablets coated with modified tamarind seed gum was comparable to the release profile of tablets coated with HPMC. **Conclusion:** On the basis of the drug release profile, it is concluded that FSG and TSG can be used as release rate controlling membrane of natural origin.

***Keywords*:** Fenugreek seed gum, pharmaceutical excipient, natural polymer

Introduction

Film coating is a most significant unit operation in the pharmaceutical industry (Shukla et al., 2017). Film coatings are used for various purposes like improvement of visual qualities of dosage forms, masking disagreeable taste or odor, improving stability and modifying the release characteristics of the drug (Ali et al., 2008). Film coating is applied to a variety of pharmaceutical products like tablets, beads, pellets, granules, capsules and drug crystal (Beraa et al., 2016). Film layer can be formed from both polymeric solution (organic solvent or aqueous based) or aqueous polymeric dispersion (commonly called latex). Polymer is the main ingredient in film coating and it may be from different origins (natural, synthetic or semisynthetic), including cellulosic, acrylics, vinyl and combination of polymers (Brummer et al., 2003). Natural polymers are cheap, easily available, non irritant, biodegradable, biocompatible and eco-friendly.

Fenugreek natural gum, it is extracted from the seed of *Trigonellafoenum graecum* (Family Leguminosae). It is cultivated in northern Africa, Canada, western Asia and India. Traditionally fenugreek seed are used in the treatment of diabetes (Dutta et al., 2005, Garg et al., 2018). Application of fenugreek seed gum have been reported as oral drug release retardant (Gowthamrajan et al., 2002, Ikoni et al., 2014, Kwok et al., 2004), binder (Nitalikar et al., 2013; Nayak et al., 2013; Nitalikar et al., 2013), mucoadhesive (Nokhodchi et al., 2008; Olga et al., 2016), emulsifiers (Rhodes et al., 1998; Rhodes et al., 2016; Rhodes et al., 2017), suspending agent (Senthil et al., 2011), gelling agent and formulation of nanoparticles (Sav et al., 2013; Shanmuganathan et al., 2016).

Tamarind seed gum (TSG) has wide application in the drug delivery (Shukla et al., 2011). It has been reported that gum, TSG can be successfully extracted from tamarind seed, using water-solvent extraction method. It can be used in the formulation of sustained release drug dosage form of water-soluble and water-insoluble drugs (Shukla et al., 2018; Rhodes et al., 1998; Rowe et al.,1978). The sustained release

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rate of the drug can be controlled by using suitable diluents like lactose and microcrystalline cellulose. For water soluble drugs, the release amount of the drug can also be controlled by partially cross linking the matrix (Reddy et al., 2012; Sauer et al., 2009). The extent of release can be varied by controlling the degree of cross-linking.

Materials and methods

Tamarind seeds, Fenugreek seeds, Paracetamol tablets were obtained from a pharmacy shop in the local market, Udaipur, Rajasthan, India. Hydroxypropylmethylcellulose. All other chemicals were used analytical grade or Pharmacopeia standards, Fresh fenugreek seed and paracetamol tablets were obtained from the Udaipur local market, India.

Isolation of fenugreek seed gum (FSG)

The seeds of fenugreek were collected and washed with water. Then after dried in hot air oven and seeds were crushed, soaked in water for 6 hours, boiled for 30 minutes and left for 1 hr to allow complete release of the gum into the water. The gum was separated by using a four-fold muslin cloth bag to remove the marc from the solution. Then ethanol (in the volumes of three times to the volume of filtrate) was added for precipitation of gum, the collected dried gum then grinded and passed through a # 120 sieve and stored in a desiccator at room temperature.

Isolation of tamarind seed gum (TSG)

The seeds of tamarind were collected and washed with water. Then after dried in hot air oven tamarind seeds were soaked in distilled water for 1 week and then the external cover was removed and obtained white part of seeds was crushed. The crushed seeds of tamarind were soaked in water for 12 hrs and boiled for 30 minutes and left for 1 hr to allow complete release of the gum into the water. The gum was separated by using a four-fold muslin cloth bag to remove the marc from the solution. Then ethanol (in the volumes of three times to the volume of filtrate) was added for precipitation of gum, the collected dried gum then grinded and passed through a # 120 sieve and stored in a desiccator at room temperature.

Modification of isolated gum with sodium-tri-metaphosphate (STMP)

1 gram STMP and 1gram natural seed gum was taken and dissolved separately in 50 ml of distilled water. Then after prepared STMP and 5ml of 0.1 N NaOH solutions were slowly added with stirring to 1gm of natural seed gum solution. The prepared solution (100ml) was stirred for 2hrs and poured into Petridis and dried at 60^0C for 24hrs. The dried complex (modified gum) was grinded and passed through a #120 aperture sieve and stored in an air-tight container at room temperature (Reddy et al., 2012, Shukla et al., 2017).

Evaluation of isolated gum (Singh et al., 2017, Tavakoli et al., 2012)

Organoleptic evaluation:

The isolated gum was characterized for organoleptic properties such as color, odor, taste, fracture and texture.

Identification tests of isolated gum

The identification of the isolated gum was carried out by using the following tests:

(a). The powder was mounted on a slide with ruthenium red solution and covered with a cover slip. After a few seconds, it was irrigated with lead acetate and the excess stain was sucked off with a blotting paper. (Lead acetate solution was added to prevent undue swelling of the test solution). The color of the particles was noted.

(b). Gum was heated with distilled water and then cooled. Formation of gelatinous mass was noted.

(c). To 2 ml of gum solution, 2-3 drops of N/50 iodine solution was added and the color of the particles was noted.

Determination of purity of Gum

To determine the purity of gum by using following tests of alkaloids, carbohydrates, flavonoids, steroids, amino acids, terpins, saponins, oils, fats, tannins and phenols.

Percentage yield

10 gm of fenugreek seed was extracted and isolated. The isolated gum was then dried and percentage yield was calculated by following formula.

% Yield = Practical Yield x 100 /Weight of sample

Solubility

One part of dry gum powder was shaken with different solvents and the solubility was determined

Swelling index

Accurately weighed amount 1gm of the gum powder was introduced into a 100 ml measuring cylinder. 25 ml of water was added and mixture was shaken thoroughly at every 10 min for 1 h. It was then allowed to stand for 3 h at room temperature. Then the volume occupied by the gum, including any sticky mucilaginous portion was measured. The same procedure was repeated thrice and the mean value was calculated, using the following formula.

$$\text{Swelling index} = (W_2 - W_1) \times 100/W_2,$$

Where W1 is the initial weight of tablet and W_2 is the weight of hydrated tablet.

Bulk density, Tapped density

The FSG powder (10 g) was accurately weighed into a 100 ml measuring cylinder and without disturbing the cylinder, the volume of powder was read to give the bulk volume. Then the volume of the powder was read after at every 50 taps till the volume of powder was constant. This represents the tapped volume of the powder. The bulk density and tapped density was calculated using equation 1 and 2 respectively.

$$\text{Bulk density} = \frac{\text{Weight of sample}}{\text{Bulk Volume}}$$

$$\text{Tapped density} = \frac{\text{Weight of sample}}{\text{Tapped Volume}}$$

Hausner quotient

Hausner ratio or quotient was calculated as the ratio of tapped to bulk densities

$$\text{Hausner's quotient (ratio)} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

Angle of repose

The flow properties of gum powder were measured by angle of repose. The improper flow of powder due to frictional forces between the particles and these friction forces were quantified by angle of repose. It can be calculated by following formula:

$\text{Tan}\,\theta = h/r$ or $\theta = \tan{-1}\ h/r$

Where, h= height of pile; r= radius of the base of the pile and θ = angle of repose.

A dry and clean funnel was fixed with burette stand at height (6 cm). A graph paper was placed on the flat surface and a sufficient quantity of the gum powder (10 gm) allowed to flow slowly through the funnel until the heap touched the tip of the funnel. The circumference of the heap was drawn and the midpoint was located and its radius was measured. The experiment was repeated thrice and the average height and radius were calculated. According to readings with the above formula, the angle of repose was calculated.

Moisture content (MC) %

An evaporated dish containing 10 g of FSG was heated to 105°C in hot air oven, till a constant weight was obtained. The average for three readings was obtained

$$\text{MC}\ (\%) = \frac{\text{Wf} - \text{Wi}}{\text{Wi}} \times 100$$

Where Wf is the final weight sample and Wi initial weight of sample.

pH of gum

Sample (5 g) was weighed in a beaker, mixed with 20 ml of distilled water, the resulting suspension stirred for 5 minutes and the pH was measured using a calibrated digital pH meter. The experiment was repeated in thrice.

Ash content %

1 gm of gum was taken in a crucible. The gum powder was spread as even layer at the bottom of the crucible. The crucible was incinerated gradually by increasing temperature to make it red hot until free from carbon. The crucible was cooled and weighed. The procedure was repeated to get constant weight. The percentage of total ash was calculated.

$$\% = \frac{\text{Weight of total ash}}{\text{Initial weightb of gum}} \times 100$$

Viscosity

Viscosity of gum was determined, by preparing different concentration of gum suspension, initially 0.4%, 0.8%, and 1% w/v concentration were prepared at 25°C. The viscosity of the prepared suspension was measured on 1st day and next day respectively, using Brookfield Rheometer (Model No. R/S- PI).

FTIR Study

100mg of the gum powder was mixed with potassium bromide (400 mg) and was compressed in a hydraulic press to form a pellet at 15 tons pressure. The pellets were scanned from 4000 to 400 cm^{-1} in a Perkin Elmer FTIR spectrophotometer.

X-ray diffraction analysis (XRD)

An X-ray diffraction spectrum was recorded on an X-ray diffraction spectrometer (Bruker, AXS/8, Berlin, Germany).

Drug excipient compatibility study by FTIR

The compatibility study of the drug with various excipients was studied by Fourier Transform Infrared Spectroscopy (FTIR, Bruker). All characteristic peaks of the drug were observed in the FTIR spectra of drug and excipients. Drug excipient compatibility study by FTIR spectra is shown in figure 1.

Coating solution

The coating solution was prepared by dissolving coating materials (2% w/v natural seed gum and 1% sodium alginate), (2% w/v modified seed gum and 1% sodium alginate), (2% w/v HPMC and 1% sodium alginate), in warm water using a magnetic stirrer. Then 0.1 % w/v talc (as antiadherant) and 0.5% w/v titanium oxide (as opacifier) were added to each of above coating solution. The solution was stirred for 60 min at room temperature. The tablets were

coated with this solution using the dip coating method and dried in hot air oven.

Viscosity of coating suspension

The viscosity of prepared coating suspensions was determined with Brookfield LVDV-IV+ digital rheometer at 100 RPM using spindle 4.

Evaluation of tablets

Weight uniformity

The evaluation was carried out on 20 tablets selected randomly and their individual weights were taken on an analytical balance (Shimadzu, EL 300, USA).

Dimensions

The diameter and the thickness of tablets were determined by using vernier caliper.

Friability

Friability of the tablets was determined using Roche Friabilator. This device subjects the tablets to the combined effect of abrasion and shock in a plastic chamber revolving at 25 rpm and dropping the tablets from a height of 6 inches in each revolution. Pre weighed sample of tablets, were placed in the friabilator and were subjected to 100 revolutions. Tablets were then de-dusted using a soft muslin cloth and re-weighed. The friability is given by the formula:

$$\%\text{Friability} = \frac{W1-W2}{W1} \text{x}100$$

Where'w_1 'is weight of the tablets before the test and 'W_2' is the weight of the tablet after the test. Limit: It should be not more than 1%.

Hardness test

The resistance of tablets to shipping or breakage under the conditions of storage, transportations and handling before usage depends on its hardness. The hardness of tablet, will measured by Pfizer hardness tester. The hardness was measured in terms of Kg/cm^2.

Disintegration time

Disintegration testing of tablets forms was carried out in the six tablet basket rack USP disintegration apparatus. One tablet was introduced into each tube of the basket rack assembly of the disintegration apparatus without disc. The assembly was positioned in the beaker containing distilled water maintained at 37±2°C and operated the apparatus for 2 hours. The disintegration time of tablet was recorded.

Evaluation of coated tablets

The coated tablets were evaluated for the following parameters like Weight, Diameters (cm), Thickness (cm), Hardness Kg/cm^2 and Disintegration time (min.) (Nokhodchi et al., 2008, 11. Nayak et al., 2013).

Dissolution studies

In-Vitro drug release of natural and modified tamarind seed gum, natural and modified fenugreek seed gum, HPMC film coated tablets was studied, using eight station (USP) Type II dissolution apparatus at 37 ± 0.5°C and at 50 rpm speed in 0.1 N HCL as dissolution media for 2hrs. From the dissolution medium 5 ml of the sample was withdrawn at the specific time intervals and replaced with an equal volume of fresh medium (5ml) to maintain constant media volume. After filtration, each sample was analyzed using double beam UV visible spectrophotometer at selected 257 nm λ max. This study was performed in three times for each batch. After 2hrs dissolution media were replaced by phosphate buffer pH 7.2. *In-Vitro* drug release data and graph of propranool hydrochloride film coated tablets shown in table 7 figure 11.

Results and discussions

After hot water extraction and ethanol treatment, tamarind seeds gum and fenugreek seeds gum yielded 18.90% w/v, 25% w/v gum respectively. The isolated gum was subjected to identification tests using ruthenium red, and by dissolving them in hot distilled water. All others tests indicated that the isolated gum were polysaccharide in nature. The results of purity tests of TSG and FSG showed the presence of carbohydrates. Other phytoconstituents were absent in the isolated powder. Results are shown in table 1.

Further the isolated gum was characterized for organoleptic properties such as color, odor, taste, fracture and texture. Results are reported in table 2.

The solubility of TSG and FSG was determined, using warm water, organic solvents such as ethanol, benzene, butanol, chloroform, and ether. The TSG and FSG formed

Table 1. Phytochemical properties of isolated FSG, and TSG

Test	FSG	TSG
Test for mucilage (Ruthenium red test)	+	+
Monosaccharide Test	-	-
Test for Tannins (Ferric chloride test)	-	-
Test for proteins (Ninhydrin test)	-	-
Test for alkaloids (Wagner's test)	-	-
Test for glycosides (Keller – Killaini test)	-	-
Test for Carbohydrates (Molisch's test)	+	+
Test for flavonoid (Shinoda test)	-	-
Test for reducing sugar (Felhing's test)	-	-

Table 2. Organoleptic properties of isolated FSG, TSG seed gum

Gums	Colour	Odour	Taste	Fracture
FSG	Yellow	Characteristics	Bitter	Irregular
TSG	Yellow	Characteristics	Bitter	Irregular

Table 3. Solubility profile of isolated FSG, TSG seed gum

Solvents	FSG	TSG
Cold water	Slightly soluble	Slightly soluble
Hot water	Viscous colloidal dispersion	Viscous colloidal dispersion
Ethanol	Insoluble	Insoluble
Benzene	Insoluble	Insoluble
Acetone	Insoluble	Insoluble

viscous colloidal dispersions with warm water, and were insoluble in organic solvents such as ethanol, benzene, butanol, chloroform, and ether. Solubility profile of isolated FSG and TSG are shown in table 3.

Results of evaluation of physicochemical properties of fenugreek gum and tamarind seed gum are reported in table. FSG, TSG Percentage yields% 25.01±.07, 18.90±.09, Swelling Index% 10.2±.02, 8.1±.034, Bulk Density 0.667±.05, 0.701±.07, Tapped Density 0.809±.08, 0.841±.01, Angle of repose 27.85±.03, 29.48±.02, Carr's index %17.55±.02, 16.64±.01, Hausner ratio1.246±.01, 1.199±.01, Moisture Content% 21.40±.01, 12.64±.02, pH of mucilage 7±.01, 6.9±.03, Ash content% 5.98±.04, 6.22±.06, respectively.

The pH value of 2% solution of the FSG and TSG was found near neutral, which indicated that the FSG is non-irritating to the mucous membrane of gastrointestinal tract, and can be used for the development of buccal and oral drug delivery systems.

The swelling index of TSG and FSG was found to be 8.1±.034 and 10.2±.02, respectively which is an indication of good water absorption, and hence, it forms a hydrated three-dimensional network from which drug can efficiently releases through diffusion.

Table 4. Physicochemical properties of isolated FSG, TSG seed gum

Parameter	Observations	
	FSG	TSG
Percentage yields%	25.01±.07	18.90±.09
Swelling Index%	10.2±.02	8.1±.034
Bulk Density	0.667±.05	0.701±.07
Tapped Density	0.809±.08	0.841±.01
Angle of repose	27.85±.03	29.48±.02
Carr's index %	17.55±.02	16.64±.01
Hausner ratio	1.246±.01	1.199±.01
Moisture Content%	21.40±.01	12.64±.02
pH of mucilage	7±.01	6.9±.03
Ash content%	5.98±.04	6.22±.06

Table 5. Determination of viscosity of isolated FSG, TSG seed gum (spindle 4 speed 100rpm) powder

S.N.	Days	0.4%		0.8%		1%	
		TSG	FSG	TSG	FSG	TSG	FSG
A	1	31±.09	33±.02	33±.07	34±.01	37±.03	43±.01
B	2	33±.07	33±.04	34±.03	35±.04	39±.01	45±.03

The result of the present study indicated that the FSG was hygroscopic and need to be stored in air-tight containers. The results are shown in table 4. Natural and modified gums TSG, FSP exhibited poor to passable flow. Hence, to improve the flow, it needs addition of glidants.

Viscosity of isolated TSG, FSG was found to 31±.09cp, 33±.07, 37±.03 cp and 33±.02cp, 34±.01 cp, 43±.01 cp at concentration 0.4, 0.8, and 1% respectively on 1st day and on next day viscosity

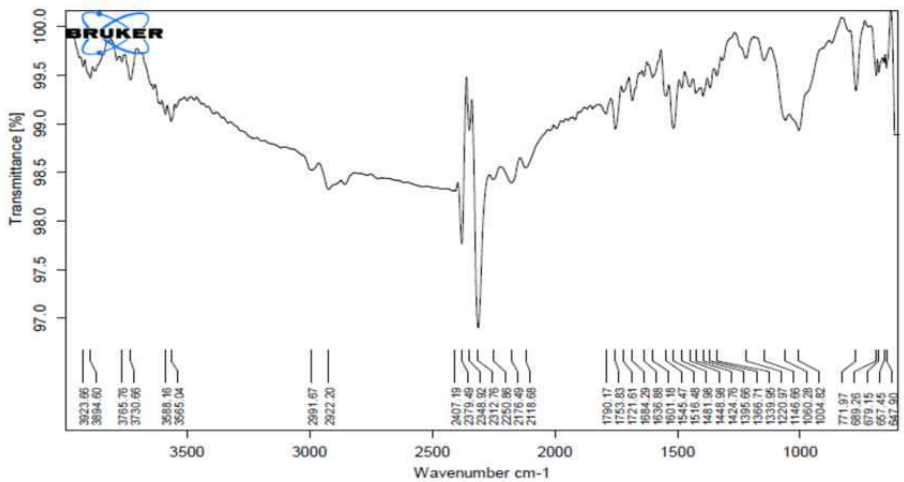

Figure 1. FTIR spectra of FSG

was found to 33±07 cp, 34±03 cp, 39±.01 cp and 33±.04 cp, 35±.04 cp, 45±.03 cp at concentration 0.4, 0.8, and 1% respectively. It indicated that as the concentration increased, drug released rate will be reduced due to swelling or gelling property of TSG and FSG. The results are shown in table 5.

The FTIR spectra of the natural and modified TSG and FSG are indicate that the TSG and FSG are carbohydrates in nature. Modified natural gum successfully cross-linked with STMP and characterization of modified gums (MFSG/MTSG) was investigated by FTIR and spectra of modified natural gums are shown in figure 1, 2, 3 and 4.

The absences of sharp peak at 1700-100 cm^{-1} in the FTIR spectrum indicate that there is no carboxylic group in the extracted sample. On the other hand, the presence of peak at

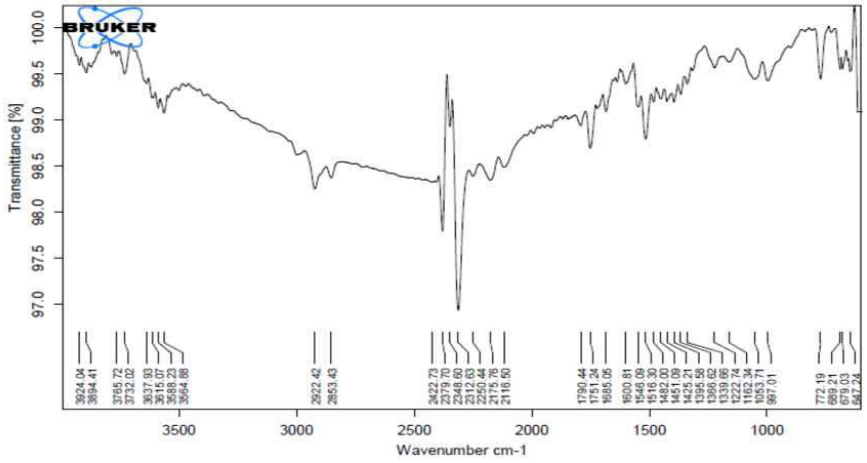

Figure 2. FTIR spectra of TSG

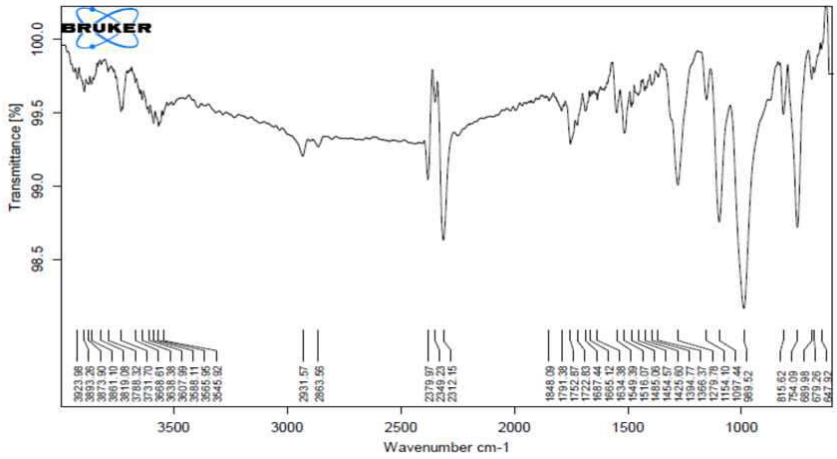

Figure 3. FTIR spectra of MTSG

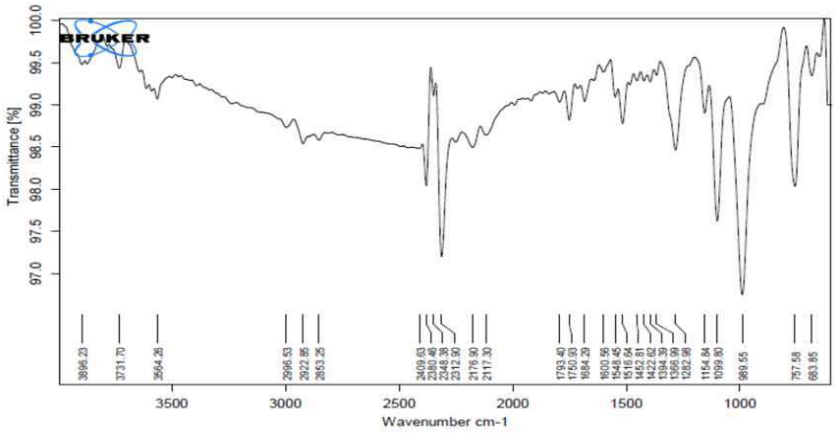

Figure 4. FTIR spectra of MTSG

1000–1200 cm^{-1} indicates the presence of secondary alcohols. Both of modified seed gums (MFSG/MTSG) FTIR spectra peak proved that there were no uronic sugars or esters in the structure. The range of peaks at numbers 800 to 1200 cm^{-1} represents carbohydrates nature.

The surface characteristics of natural and modified gum of TSG and FSG were studied, by using XRD. The XRD of natural FSG, TSG indicates high rough surface compare to modified natural gum with pores and crevices on it, (Figure 5 and 6).

From XRD It is evident that the particle size of the powders was not uniform and the size distribution was not within a narrow range. The powder contains larger to ultra-fine particles. This might be the reason for the 'heavy' nature of the powders. The powders exhibit a 'closet' packing arrangement, in which, the smaller particles fill the voids between larger particles and reduce the bulkiness. The low porosity values also indicate this packing arrangement. The close packing can also be responsible for poor flow properties of FSG and TSG. All the formulations had a low friability profile <1%. XRD spectra of natural and modified seed gum are shown in figure 7 and 8.

The viscosity of coating solution was determined by using Brookfield viscometer spindle-4 at 100 rpm. Viscosity of coating solution was found as TSG-SA 220±.01 cp, FSG-SA 236±.03 cp, MTSG-SA 107±.07 cp, MFSG-SA 103±.02, cp, HPMC-SA 202±.06 cp.

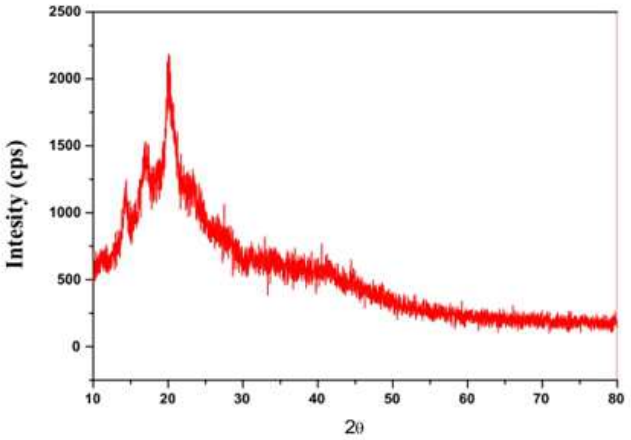

Figure 5. XRD spectra of FSG

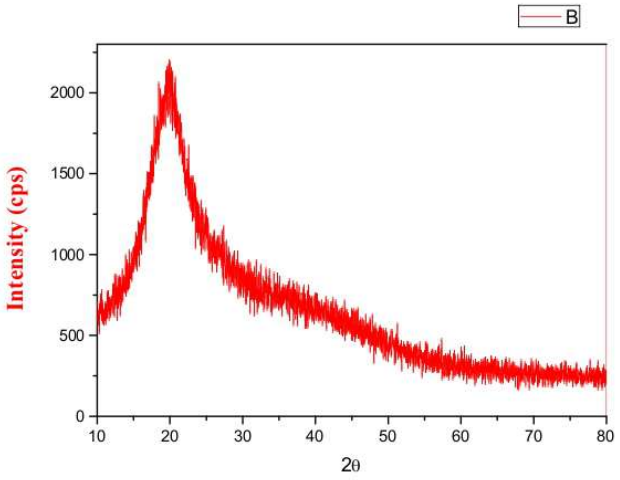

Figure 6. XRD spectra of TSG

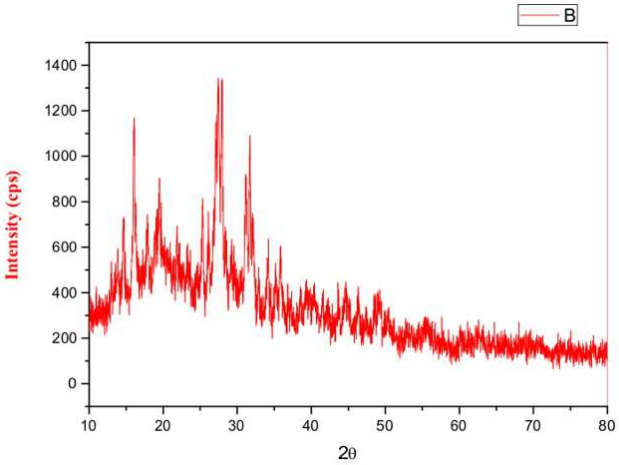

Figure 7. XRD spectra of modified fenugreek seed gum MFSG

Paracetamol tablets were coated with TSG-SA, FSG-SA, MTSG-SA, MFSG-SA and HPMC-SA. The evaluation of coated tablets was found, satisfactory as average weight 678-683±.01, disintegration time 4.1-15.05±.03 (min), diameters 12.6-13.1±.04 (mm), thick-ness 4.14-4.33 ± 0.04 (mm) and hardness 6.1-12.8± 0.01 the results are shown in table 6. The coated paracetamol tablets with HPMC showed better results as compared to those coated with natural and modified fenugreek gum and tamarind seed gum. The order of disintegration time of formulation was found: HPMC>TSG>MTSG>FSG>MFSG >core, respectively.

Table 6. Evaluation of film coated paracetamol tablets

Description	Core	TSG	FSG	MTSG	MFSG	HPMC
Weight mg	683±.01	680±.04	681±.02	680±.04	678±.02	679±.01
Disintegration time (min)	4.1±.03	11.03±.01	12.09±.02	11.06±.04	10.20±.01	15.05±.03
Diameter (mm)	12.6 ± 0.28	13.1±.04	12.9±.03	12.2±.07	12.1±.01	12.6±.06
Thickness (mm)	4.14 ± 0.01	4.33 ± 0.04	4.32 ± 0.08	4.35 ± 0.07	4.30 ± 0.01	4.30 ± 0.01
Hardness kg/cm^2	6.1± 0.08	12.4± 0.03	12.4± 0.02	11.7± 0.01	11.6± 0.03	12.8± 0.01

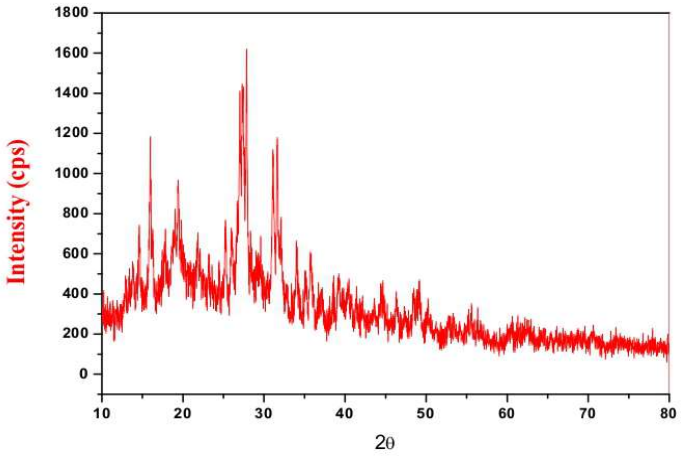

Figure 8. XRD spectra of modified tamarind seed gum MTSG

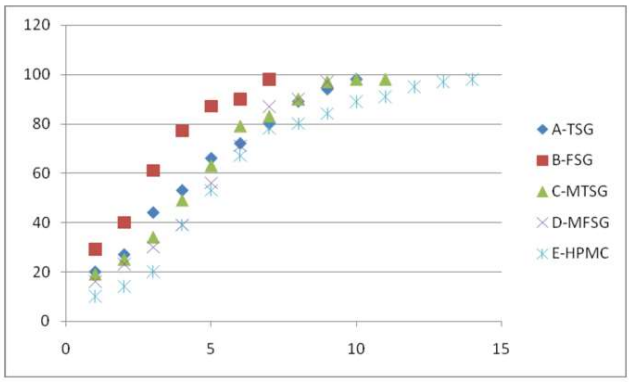

Figure 9. *In-Vitro* drug release from film coated tablets of paracetamol

Table 7. *In-Vitro* drug release study from prepared film coated tablets of paracetamol

HRS	A-TSG	B-FSG	C-MTSG	D-MFSG	E-HPMC
1	20.33±04	29.51±02	19.70±07	16.71±02	10.2±08
2	27.07±06	40.52±09	25.81±06	23.40±01	14.12±02
3	44.91±02	61.24±03	34.31±04	30.91±05	20.83±01
4	53.34±01	77.71±06	49.33±03	39.34±02	39.6±04
5	66.65±06	87.67±01	63.61±07	56.70±01	53.47±01
6	72.23±02	90.52±04	79.80±01	71.2±07	67.51±04
7	80.37±08	98.23±02	83.16±02	87.8±01	78.32±01
8	89.48±02		90.21±05	90.61±01	80.71±05
9	94.77±09		97.18±03	97.45±02	84.48±01
10	98.52±05		98.05±01		89.54±03
11			98.57±02		91.95±05
12					95.73±02
13					97.9±01
14					98.96±06

The tablets coated with natural and modified tamarind seed gum release the drug up to 10 hrs and 11 hrs, respectively and natural and modified fenugreek seed gum release the drug up to 7 hrs and 9 hrs respectively. The tablets coated with HPMC-SA released the drug up to 14 hrs. The release profile tablets coated with modified tamarind seed gum was comparable to the release profile of tablets coated with HPMC. *In-Vitro* drug release study of film coated tablet of paracetamol tablets were shown in table 7 and figure 9.

Conclusion

The potential of natural and modified fenugreek seed gum and tamarind seed gum was investigated using paracetamol as model drug and found that natural and modified form of the gum have potential as release controlling polymers of natural origin through in present investigation through gum and modified tamarind gum were found to have better release rate controlling potential then the fenugreek gum.

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