RESEARCH ARTICLE

Formulation and Evaluation of Mucoadhasive Tablets by using Thiolated *Cassia sophera* Seed Polysaccharide as A Bioadhasive Material

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Received: 26th Aug, 2024; Revised: 08t Oct, 2024; Accepted: 17th Nov, 2024; Available Online: 25th Dec, 2024

ABSTRACT

Objective of current investigation is extraction and chemical modification of seed polysaccharide from seeds of *Cassia sophera*. Isolated and modified polysaccharide was evaluated for phytochemical investigation, degree of thiol group substitution, FTIR, DSC, XRD, Zeta Potential. Ondansetron hydrochloride, was selected for formulation of mucoadhesive buccal tablet consisting natural and thiolated seed polysaccharide. The study investigated the physicochemical characteristics of extracted and modified seed polysaccharide as a suitable mucoadhesive agent When comparing modified and untreated tablets, the ones with the strongest mucoadhesive strength were those whose concentrations of modified polymer rose with time. Mucoadhesive ondansetron tablets are made in this study by using thiolated *Cassia sophera* to treat emesis. The formulation has been manufactured successfully and exhibits optimal drug release to yield the intended therapeutic effects.

Keywords: *Cassia sophera*, mucoadhasive tablet, bioadhasive material, seed polysaccharide.

How to cite this article: Bhandari H, Wagh R. Formulation and Evaluation of Mucoadhasive Tablets by using Thiolated Cassia sophera Seed Polysaccharide as A Bioadhasive Material. International Journal of Drug Delivery Technology. 2024;14(4):2267-72. doi: 10.25258/ijddt.14.4.45

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Because natural polysaccharides are inexpensive, readily available, and non-toxic, they are favored over manufactured polymers. When partially dissolved in water, mucilage expands and produces a gel. *Ocimum gratissimum*, *Plantago ovata*, *Eulophia campestris*, okra, and dika nut mucilages have all previously been assessed for their potential use in pharmaceutical applications as mucoadhesive, and sustained release matrices.[1] Majority of tropical nations like India are home to the annual, upright shrub *Cassia sophera* (Linn.) of the Caesalpiniaceae family. Known as "Kasondi," *Cassia sophera*, Linn. (Caesalpinaceae) is a significant Unani medicine. The plant can be found all throughout India. It is typical in woodlands, on the sides of roads, and in waste areas. In addition to its common names, Kasaundi (Hindi), Rantakada (Marathi), Kalkasunde (Bengali), Poonaverie (Tamil), etc., the plant is also known by its English name, Senna. Solid unit dosage forms for pharmaceutical administration have been made using mucilage from *Cassia sophera* as a binding agent.[4]

MATERIALS AND METHODS

Materials

Chemicals, excipients were received from research laboratory store department. Ondansetron hydrochloride was gifted by Intas Pharmaceuticals. Seeds from plant *Cassia sophera* were collected from suburban areas of Nashik, Maharashtra. Analytical grade reagents were used for laboratory procedure.

Methods

Extraction of *Cassia sophera* seed polysaccharide

Polysaccharide from seeds of *Cassia sophera* was extracted by aqueous maceration and acetone was used for precipitation. The mucilage was released into the water by steeping the *Cassia sophera* seeds in water (24 hours), cooking those (2 hours), and then letting them cool. By compressing the contents of a muslin bag, Mark is extracted from the filtrate. When the filtrate is mixed with an equivalent volume of acetone, the mucilage is precipitated. Seed polysaccharide was separated, dried at roughly 50 ^{0}C in an oven, ground into a powder, and then put through sieve number 80. Before being used again, the powder was kept in a desiccator.[5]

Esterification *Cassia sophera* seed polysaccharide

Thiolation of isolated *Cassia sophera* seed polysaccharide was accomplished via esterification by using thioglycolic acid in acidic condition. 50 milliliters of distilled water were used to dissolve 6 grams of *Cassia sophera* seed polysaccharide. 3.6 milliliters of thioglycolic acid and 2 milliliters of 7N hydrochloric acid were poured to the solution mentioned above. For 180 minutes, the reactants were allowed to react at 800C. To precipitate the thiolated *Cassia sophera* seed polysaccharide, pour resulted solution in 500 milliliters of methyl alcohol. Three times, methanol was used to wash the resulting creamy white precipitate and spent four hours frozen at -80^{0}C.[6]

Phytochemical analysis and polysaccharide content estimation

Isolated polysacharide went through qualitative analysis to investigate various phytochemicals, including Ruthenium red test, Iodine test, Molisch's test, Ninhydrin test,

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Table 1: Formulation of Ondanstron hydrochloride buccal tablet.

API and Excipients (mg)	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
Ondansetron HCl	16	16	16	16	16	16	16	16	16
CP Polysacharide	20	40	60	80	-	-	-	-	-
T-CP Polysacharide	-	-	-	-	20	40	60	80	-
Tragacanth	-	-	-	-	-	-	-	-	60
MCC	185	165	145	125	185	165	145	125	145
PVP K30	20	20	20	20	20	20	20	20	20
Talc	5	5	5	5	5	5	5	5	5
Mg. Stearate	2	2	2	2	2	2	2	2	2
Total Weight	248	248	248	248	248	248	248	248	248

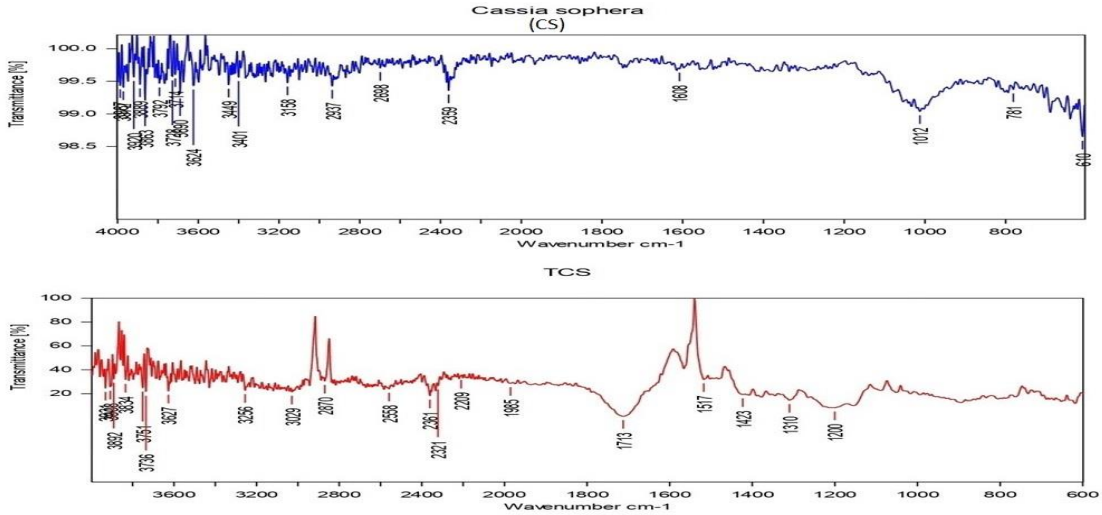

Figure 1: FTIR Spectra of CS and TCS seed polysaccharide

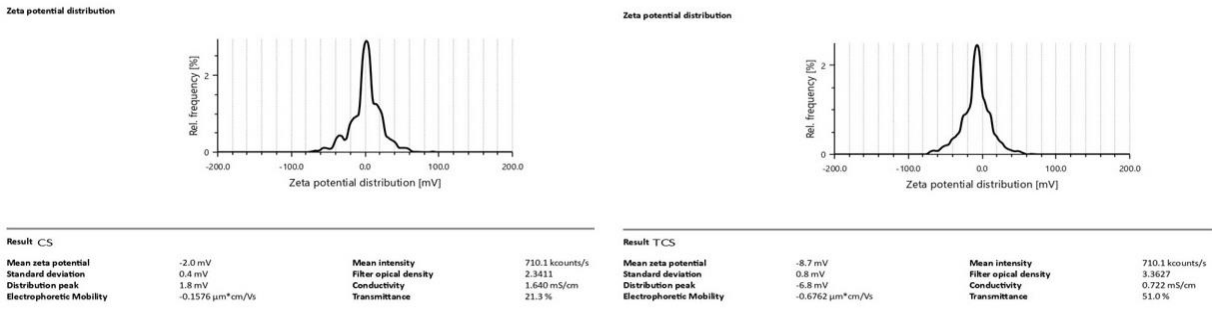

Figure 2: Zeta Potential of CS and TCS seed polysaccharide

Dragendorff"s test for glyacoside, Legal test for alkaloids and ferric chloride test for tannins.[7]

Confirmation of thiolation

As indicated in previous study, the amount of thiol substitution in galactomannan was determined spectrophotometrically using Ellman's reagent.[8]

Characterisation by FTIR CP and TCP seed polysaccharide

FTIR spectra were captured using an FTIR (Bruker Alpha) spectrophotometer. After that, the sample was placed onto the FTIR sensor (Bruker Alpha). The isolated and thiolated seed polysaccharide was subjected to structural and functional group identification using the spectrum acquired (Range: 4000–400 cm^{-1}).

Measurement of Zeta potential

Anton Par DLS Litesizer 500 was used to assess zeta potential of both isolated and modified galactomannan. Isolated and thiolated seed polysaccharide was dispersed in distilled water to create the sample (0.1% v/v). After that, the sample was moved to an Omega cuvette for measurement. 170 degrees was the fixed back scattering angle, and the measurement was performed at 25^0C.[9]

Preparation Method

Nine formulations were prepared out of them code from

Table 2: Thermal behavior of CS and TCS by DSC.

Parameter	CS	TCS
Endothermic peak	46.7°C-	30.2°C-
Onset & End set	109.2°C	140.7°C
Glass Transition	188.8°C-246.6°C	179.3°C-211.8°C
Decmposition	Above 270°C	Above 242.9°C

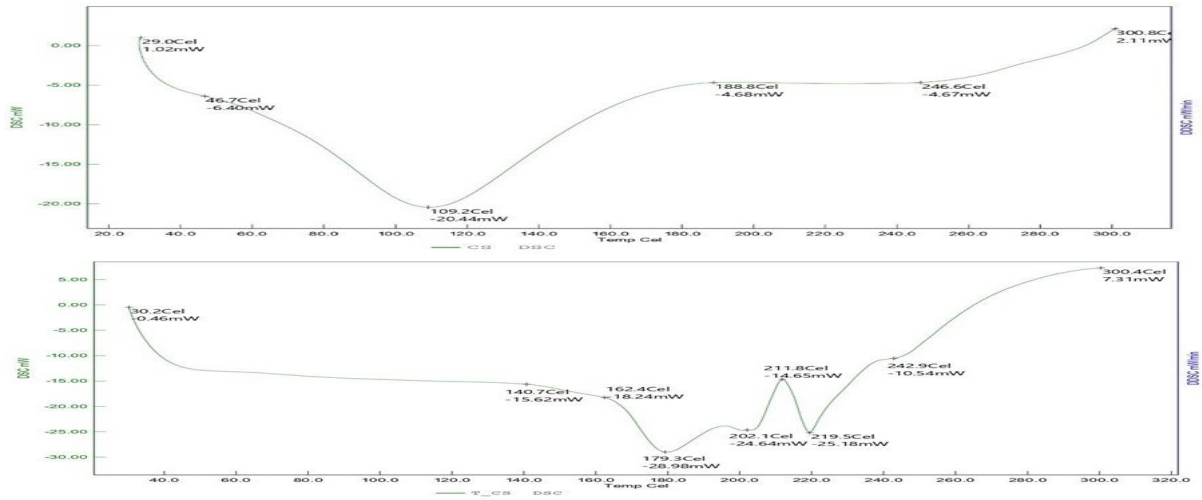

Figure 3: DSC of CS and TCS seed polysaccharide.

Table 3: Ondansetron mucoadhesive tablet formulation F1–F9 precompression parameters for dry powder mixes.

Formulation Batch	Bulk density (g/cc) *	Tapped density (g/cc) *	Compressibility Index (%)	Hauser's ratio	Angle of Repose (Ɵ)*
F1	1.014±0.017	1.55±0.018	18.52	1.20	30.98±0.88
F2	0.99±0.025	1.22±0.027	18.11	1.25	28.42±0.65
F3	0.841±0.020	1.05±0.015	16.81	1.23	25.01±0.53
F4	0.964±0.034	1.00±0.014	13.61	1.15	29.12±0.70
F5	0.912±0.036	0.821±0.016	12.78	1.13	28.02±0.70
F6	0.841±0.040	0.667±0.019	11.11	1.10	28.65±0.56
F7	0.684±0.034	0.750±0.014	11.61	1.18	29.12±0.70
F8	0.660±0.037	0.636±0.035	10.06	1.15	30.41±0.52
F9	0.512±0.036	0.525±0.027	10.78	1.15	30.02±0.70

F1 to F4 formulated by using isolated polysaccharide, F5 to F8 formulated by using thiolated polysaccharide and F9 formulated by using tragacanth as a reference film forming agent (Table 1). We used the direct compression method to make the tablets.[10]

Calibration Curve Preparation

Ondansetron HCl was analysed utilising a UV-spectrophotometer at 310 nm.[11]

Pre-formulation studies

Studies conducted prior to formulation are known as pre-formulation studies. Before making the final preparations, it is crucial to do these kinds of research because they aid in determining the drug's characteristics and its compatibility with other substances.[12]

Swelling index

By inserting the mucilage up to the 2 ml mark in the 10 ml measuring cylinder, the swelling index of isolate and modified seed polysaccharide was calculated. In a measuring cylinder, the gum's original volume was recorded. 0.1N HCl (pH 1.2) was added to the volume until it reached the 10-milliliter level at room temperature. The cylinder was sealed, given a little shake, and left for a whole day. After 24 hours, the gum sediment's volume was measured.[13] The swelling index of the gum was calculated by using the standard formula.

Determination of pH of the gum

A pH meter was used to measure the pH of a 1% w/v aqueous solution of isolated and modified *Cassia sophera* seed mucilage.

Viscosity

Using a Brookfield viscometer, the viscosity of a 1% (w/v) isolated and modified seed polysaccharide was measured at 25°C.

Characterization of seed polysaccharide by FTIR

FTIR spectra of isolated and modified mucilage seed were recorded with an FTIR spectrophotometer (Bruker Alpha). Subsequently, the material was put onto the Bruker Alpha FTIR sensor. Using the spectra obtained within 4000–400 cm−1 range, structural and functional group identification was applied to isolated and modified mucilage.

Study of Differential scanning calorimetry

DSC was used to examine the separated and altered mucilage (Hitachi High Tech, DSC 7020, Germany, India). Five to ten milligram samples were each put into an aluminium pan that was sealed. Samples were scanned at 20°C per minute across (40°C to 400°C). To increase baseline stability and cooling efficiency, controlled cool nitrogen gas was used. Angle of repose, carr's index, density (tapped, bulk) and ratio of Hausner was calculated by using standard method.

Post-compression studies

Direct compression method was used to make the ondansetron tablets for oral disintegration from isolated and modified *Cassia sophera* seed polysaccharide. Table 2 tabulates the tablet composition. The assessment of every formulation that was put through a battery of tests including weight fluctuation, friability, content uniformity, hardness and disintegration time, and dissolution.[14,15]

Table 4: Post compression parameters for Ondansetron HCl Mucoadhasive Tablet.

Formulation Batches	Hardness (Kg/cm^2) *	Thickness (mm)*	Friability (%)*	Weight variation (%)*	Drug content (%)*	Swelling Index (%)	Muchoadhesive Strength* (gm)
F1	4.8±0.10	2.31±0.01	0.26±0.014	1.032	94.76±0.17	21.24±0.37	30.5 ± 1.2
F2	4.5±0.20	2.44±0.03	0.41±0.031	1.099	97.69±0.21	24.51±0.28	32.2 ± 1.4
F3	4.4±0.21	2.14±0.03	0.33±0.013	1.036	94.33±0.15	27.10±0.29	40.6 ± 1.5
F4	4.5±0.22	2.17±0.04	0.45±0.042	1.088	91.42±0.18	29.57±0.42	43.0 ± 1.3
F5	4.7±0.15	2.14±0.01	0.33±0.028	1.023	95.26±0.16	35.82±0.38	49.7 ± 1.6
F6	4.8±0.12	2.23±0.01	0.24±0.017	1.001	95.45±0.19	37.47±0.45	58.2 ± 1.3
F7	4.5±0.25	2.17±0.03	0.43±0.0.030	1.036	98.64±0.12	40.35±0.43	59.9 ± 1.7
F8	4.7±0.12	2.18±0.01	0.34±0.028	1.006	96.26±0.16	45.88±0.38	60.2 ± 1.5
F9	4.4±0.21	2.39±0.03	0.33±0.013	1.036	99.00±0.15	46.71±0.38	60.5 ± 1.6

Table 5: % Drug release for Ondansetron HCl Mucoadhasive Tablet.

0	0	0	0	0	0	0	0	0	0
0.5	26.8	25.8	25.8	26.3	22.7	25.7	17.0	18.8	24.1
1	56.9	50.9	60.9	38.7	34.1	33.1	20.1	26.3	46.4
2	70.6	71.6	70.6	48.9	40.3	39.3	26.9	38.7	59.9
3	91.8	89.8	79.8	56.9	42.5	47.5	33.3	48.9	67.4
4	97.3	91.3	89.3	74.6	57.5	57.5	40.6	56.9	74.9
5	-	98.5	98.9	94.9	61.1	60.1	50.6	74.6	79.9
6	-	-	-	-	65.0	70.0	60.8	84.9	82.0
8	-	-	-	-	71.4	78.4	72.2	90.6	86.4
10	-	-	-	-	80.2	88.2	83.5	94.8	90.3
12	-	-	-	-	89.8	80.8	85.3	95.3	94.6
14	-	-	-	-	93.7	92.7	93.0	97.1	97.9
16	-	-	-	-	97.5	96.2	97.3	-	-

Hardness and Thickness

A Monsanto hardness tester and vernier calliper were used to measure the tablets' hardness and the thickness respectively.

Friability

A sample of eight tablets was tested for friability using a USP-type Roche friabilator Crosslab by using standard procedure.

Testing the Stickiness of Mucoadhesive Materials

Each tablet formulation was tested three times using a texture analyser to determine its mucoadhesive strength. Approximately fifteen We used the following formula to calculate the mucoadhesive force: The force of adhesion (N) is equal to the bioadhesive strength (g) divided by 1000 and then multiplied by 9.81.

RESULTS

The brown, amorphous powder that was extracted from *Cassia sophera* seeds was mucilage. *Cassia sophera* seed mucilage had an extraction yield of 11.66%. The chemical synthesis of thiolated *Cassia sophera* seed polysaccharide yields 51.55%. The seed is yellowish brown in hue. A phytochemical analysis revealed the lack of starch etc. along with the presence of polysaccharides, carbs, and mucilage. By measuring the quantity of the thiol group using Ellman's reagent, it was determined that the isolated seed polysaccharide had 3.1 mmol per gramme of thiolgroup substitution, confirming that the CS seed polyscharide had been modified with thiol.

FTIR

IR data of CS seed polysaccharide showed broad absorption band on wave number 3158 CM-1 (O-H stretching), 2937 cm-1 (C-H stretching), 1608 cm-1 (CO stretching) and 1012 CM-1(C-H bending) (presence of polysaccharide) in test sample.IR spectra of TCP showed peaks at 2558 CM-1(S-H stretching), 1517 CM-1 (CO stretching of ester) and 1423 CM-1 (CO stretching of carboxyl group).Presence of 2558 CM-1 (SH Stretching) and more intensity of CO stretching at ester confirms thiolation of CP to TCP. IR Spectra for CS and TCS were reported (Figure 1).

Zeta Potential

Zeta potential for CS and TCS was found to 2.0 mV and 8.7 mV respectively (Figure 2).

DSC

Changes in thermal behavior indicating possible thiolation of seed polysaccharide obtained from *Cassia sophera* plant. DCS plots for CS and TCS showed in Table 2 and Figure 3.

Preformulation study

Preformulation study was conducted and reported in (Table 3).

Post Compression evaluation

Post compression evaluation parameters for all F1- F9 were optimum as per I.P limits. Therefore, thiolated polysaccharide containing tablets exhibited optimum swelling when compared with tragacanth due to the mucoadhesive nature of polysaccharide. Due to little mucoadhesive nature of isolated polysaccharide, batches F1-F4 showed negligible sustained release effect. On other hand there is

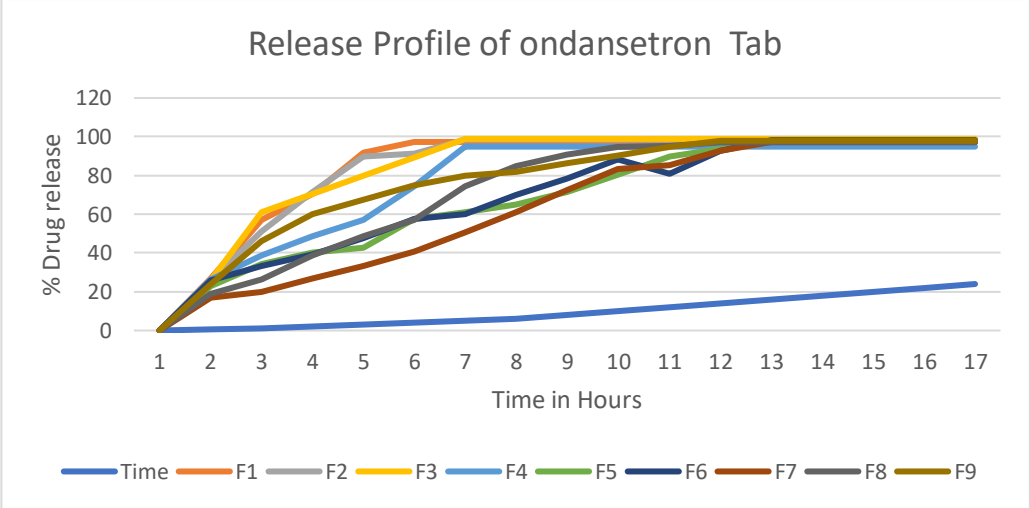

Figure 4: Drug release profile of Ondansetron HCl mucoadhesive Tablet.

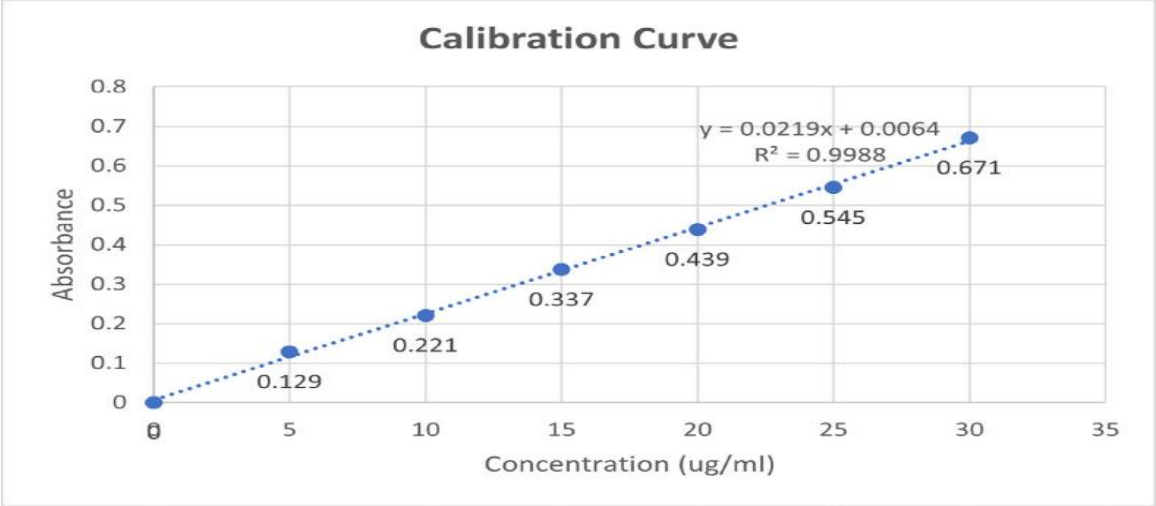

Figure 5: Calibration curve Odansetron.

increased mucoadhesive nature of tablet containing thiolated polysaccharide (F5-F8) as showed in Table 4. Drug release from F5-F8 was up to 12 hours and 97 % which showed suitability of thioated polymers for sustaining medicament in buccal mucosa (Table 5 and Figure 4).

CONCLUSION

Cassia sophera seed polysaccharide thiolation was examined. Thiolated polysaccharide is studied using FTIR, DSC, and Zeta potential. Ondansetron mucoadhesive tablets simplify administration and improve compliance. Ondansetron mucoadhesive tablets for chemotherapy-induced emesis were sustained-release thiolated seed polysaccharide. Transmucosal buccal oral delivery decreases doses best. The study found that higher levels hinder release. These polymers produced Formulations F7 and F8, which delivered medications for 14 hours without local irritation and had excellent surface pH and physical properties. F7 and F8 outperformed isolated raw polysaccharide in swelling index, mucoadhesion, and drug release. Pharmacopoeial thickness, friability, hardness, weight variation, medication concentration, surface pH, mucoadhesive strength, force, and swelling index were met by F5-F9. In *in-vitro* dissolving experiments, Ondansetron releases continuously for 12 hours. Thiolation makes natural polysaccharides drug delivery film-formers stickier, according to this study.

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